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Past-Presidents.

* Deceased.

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PRESIDENTIAL ADDRESS.

I.—MICROSCOPE ILLUMINATION WITH TRANSMITTED LIGHT.

By CONRAD BECK, *C.B.E.*

(*Delivered January 18th,* 1933.)

THREE TEXT-FIGURES.

So much depends upon illumination in high-power microscopic technique when using transmitted light that an address to a microscopical society on this subject appears to be justified.

In running over the points that are familiar to all we may touch on some that are not so obvious, and that must be my excuse for including matters that every microscopist knows.

The time when there was some question as to the necessity of using a substage condenser for illuminating objects examined with high and moderate power object-glasses is passed.

It is therefore important to realize what is the true function of the substage condenser. It is not to increase the intensity of the illumination—that can be done by the use of stronger sources of light, so many of which are now available. Its function is to throw light through the object into the object-glass at such an angle or at such angles that the aperture of the object-glass is either partially or completely filled with light, as desired. It is true that the more the aperture is filled with light the greater will be the intensity of illumination, but this change in illumination is a positive disadvantage, because it means that it is necessary to reduce or increase the intensity of the

light source in order to equalize the illumination when different amounts of the aperture of the object-glass are filled with light to suit different requirements.

The condenser with its iris diaphragm open should throw upon the object a very wide-angled cone of light and all that light should enter the object-glass up to the limit of the aperture of the object-glass in use. The angle of the cone can then be regulated by the iris diaphragm of the condenser or special parts of the aperture can be illuminated by stops or patches.

In order to ascertain the character of the illumination it is necessary to examine the aperture of the object-glass. The eyepiece of the microscope having been removed, the aperture of the object-glass can be sufficiently well seen by looking down the tube, especially if a lens of 8 or 10 inches
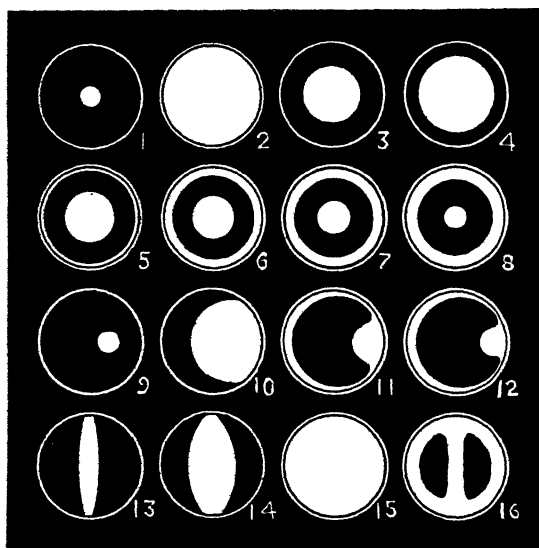
FIG. 1.

focus can be used as a magnifier, holding it so that the margin of the back lens is sharply in focus. It is better to put a low-power object-glass in the end of the drawtube and use a low-power eyepiece. This turns the drawtube into a microscope which can be slid up and down till the margin of the back lens is accurately in focus. Another method is to examine the Ramsden disc, which is an image of the back lens of the object-glass, and when it is examined with a high-power magnifier the back lens of the object-glass will be seen. This method requires accurate focusing of the magnifier.

The diagram (fig. 1) will indicate what will be seen with the two chief types of substage condenser.

The achromatic and aplanatic condensers should be — and generally are—corrected almost as perfectly as an object-glass. They produce a well-defined clear image of the source of light in their focal plane. To examine

their action we should use a small source of light or a small diaphragm in front of a large source. When the condenser is considerably below the position of correct focus, examination of the back lens of the object-glass shows a small disc of light in the centre of the aperture (fig. 1 (1)), indicating that only a narrow cone of light is being thrown through the object into the object-glass. As the condenser is focused upwards the disc increases in size until when the source of light is focused upon the object the whole aperture is filled with light (fig. 1 (2)). If it is focused higher up still the disc begins to be reduced in size. The only position where the whole aperture of the object-glass is completely filled with light is when the source of light is almost or quite focused upon the object. Just a short range on either side of the exact focus gives a completely filled aperture. The disc, whether large or small, is an evenly illuminated disc. If a large instead of a small source of light is used it slightly increases the range of focus in which the whole aperture is filled, and when it is focused away from this position the size of the disc in the centre of the aperture is not reduced so rapidly. When the whole aperture of the object-glass is filled with light, closing the iris diaphragm or introducing stops or patches enables any portion of the aperture to be utilized at will. If either the light or the condenser is not truly centred the whole aperture is not filled with light. Only half or even a quarter may be illuminated (fig. 1 (10)), and when the condenser is out of focus the illuminated disc will not be in the centre of the aperture (fig. 1 (9)).

The second form of condenser is generally known as the Abbe condenser. The name is incorrect, as the distinguishing feature of the Abbe condenser was its arrangement of iris diaphragm and stops, and the optical system conformed to the early types of only partially corrected lenses. One is obliged, however, to use this name to designate the partially corrected type, as it has gained universal application. There are two general forms, two lens systems with a N.A.1, and three lens forms with higher apertures up to 1·4 N.A. The 1 N.A. is in most general use, because a larger aperture than 1 N.A. can only be obtained by using it in immersion contact with the under-surface of the slip. The spherical aberration in both forms is very imperfectly corrected. In the 1 N.A. form the difference in the focal plane for the central and oblique rays is about 2 mm.

Carrying out the same examination of this type of condenser by examining the back lens of the object-glass, we find that when the condenser is considerably below the position of focus a small circular disc of light as before (fig. 1 (1)) is seen in the centre. As it is brought into focus this disc enlarges up to a maximum size that represents about 0·5 N.A. (fig. 1 (3)), after which it reduces in size and a ring of light appears around the margin of the aperture, leaving a dark ring in between (fig. 1 (5)). The central disc then is reduced in size and the marginal disc increased (fig. 1 (7, 8)). At no position when the source of light is small will it fill the whole aperture of, say, $\frac{1}{6}$th 0·85 N.A. If the size of the source of light be increased the maximum disc obtainable is increased, but in order to fill the aperture of $\frac{1}{6}$th 0·85 N.A. (fig. 1 (2)) it

requires a source of light in the neighbourhood of $1\frac{1}{2}$ inches diameter, 8 inches from the mirror of the microscope. Below the focus it will be a disc, but above the focus it will always be a central disc and a marginal ring with a dark space between. If the aperture of, say, 1 N.A. is to be completely filled with light, a very large source of light is required with this form of condenser.

The diagrams (fig. 1 (11, 12)) show the unsymmetrical manner in which the aperture is illuminated by a bad condenser when the light or the condenser is out of centre.

The illuminant for these experiments has been assumed to be in the form of a circular disc either small or large. If the source of light has an irregular shape and the condenser of the best type is in focus, the aperture will be equally filled with light. That portion of the aperture which is equally filled with light with a bad condenser will not be changed, but in both cases when the condenser is out of focus the illuminated portion of the aperture will approximate in shape to that of the source of light. The edge of a lamp flame forming a strip of light was at one time a favourite method of illumination, and the diagram (fig. 1 (13–16)) shows the effect of its use with a good and a bad condenser. Fig. 1 (13, 14, 15) shows a good condenser in and out of focus ; fig. 1 (16) shows a bad condenser above its focus.

Experiment shows that if the aperture is unequally filled with light, whenever it is not in the form of a disc, large or small, definition is most seriously injured. If it is badly out of centre (fig. 1 (9–12)) or if a central disc with a bright marginal ring of the aperture is illuminated (fig. 1 (5–8)) definition may be completely ruined. The irregular shapes produced by irregularly shaped sources of light out of focus will also damage the quality of the image. Even the simplest experiments show how much the image is impaired by an unequally illuminated aperture in the object-glass. The reason why this should be so is not obvious. Each point of the object is seen by rays of light passing through that point to a point in the image. Why should it matter which rays are used to produce the image point ? The quality of the object-glass scarcely affects the result. With unequal illumination the same bad images are produced with both good and bad lenses. Errors, it is true, are produced by diffraction when the rays are not a symmetrical bundle, but these are of a smaller order and do not account for · the very serious lack of definition referred to above.

We must consider the curious and abnormal way in which a microscope observes an object. The eye examines an object by means of a minute bundle of rays from each point. A high-power microscope sees round a large portion of each small element at once. The diagram (fig. 2 (A)) represents a $\frac{1}{8}$-inch 0·85 N.A. examining a small spherical spot. The rays from all parts of this spot form the image. How we get anything but a confused image is a mystery, and whether what we see in the microscope closely resembles the original is a question, but it is easy to imagine that if the light comes from only one side, as in fig. 2 (B), or from a small patch in the centre and a ring round the edge, as in fig. 2 (C), the image will be seriously

affected. It is therefore reasonable to expect that a symmetrical illumination will give a better dioptric image, and we know that it will give a better diffraction image, and in practice it does so. We may therefore conclude that the light should always be centred. An uncorrected condenser should never be used nearer to the object than its focus. A small source of light is preferable or a large area of the object will be illuminated, which may cause glare, and a badly corrected condenser can only fill the whole area of the aperture of a wide-angle object-glass with a large source of light. No condenser will completely fill the aperture of a wide-angle lens unless the source

A

B

C
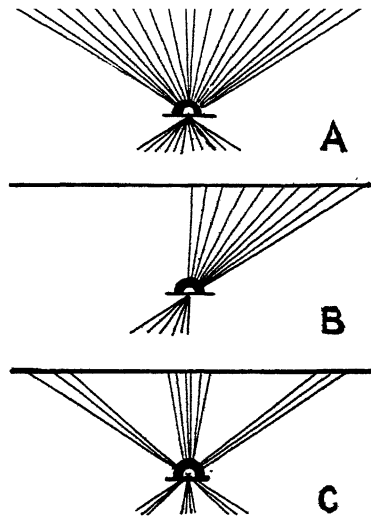
Fig. 2.

of light is nearly in focus on the object. It should never be quite in the exact focus, as a special form of glare is then introduced, the cause of which has not been satisfactorily explained.

This narrows the question down to the effect on the image produced by a larger or smaller evenly illuminated portion of the aperture of the object-glass being filled with light. A most instructive experiment is to examine such an object as a stained specimen of a beaded tubercle bacillus with a $\frac{1}{12}$-inch object-glass and a very high-power eyepiece with the condenser considerably out of focus. Only a small central zone of the aperture is filled with light. As the condenser is gradually brought into focus, thus gradually filling the aperture, the resolution steadily improves, until when the whole aperture is filled with light the best result is obtained. When it goes beyond the focus the resolution falls off again. The same result is obtained more conveniently by first setting the condenser almost in focus and varying the aperture with the iris diaphragm.

We may safely conclude that the absolute maximum of resolution is only obtained if the whole aperture of the object-glass is filled with light, but if the aperture of the object-glass is only half filled with light do we get only

half the resolution ? If the object-glass itself has its aperture cut down by half we only get half the resolution, but if the illuminating cone of light is cut down to one-half it will be found that we get a great deal more than half the resolution. We do not get the maximum, but we get a large increase, which appears to indicate that the object itself scatters enough light to make partial use of the rest of the aperture. It is quite reasonable to suppose that with a periodic structure which scatters a large amount of light by diffraction, such should be the case, but it is surprising to find it true with a small group of stained bacilli on an otherwise unoccupied and bright field of view. This fact is readily demonstrated if we place an iris diaphragm behind the object-glass, and first closing the iris diaphragm of the condenser and then that behind the object-glass to a corresponding size. It seems to call for further examination.

The practical conclusion is that if the aperture of the object-glass is filled to, say, three-quarters of its area, although we may not reach the absolute maximum of resolution, we shall get very near to it. The important consideration then arises—do we always want the maximum resolution ? A $\frac{1}{6}$th 0·85 N.A. will resolve in the neighbourhood of 80,000 lines to the inch. If a low-power eyepiece is used with it the eye cannot see more than about 40,000 lines to the inch, so that there is no advantage in having an image that shows 80,000 lines to the inch if they cannot be seen. It is only in using a high-power eyepiece that its resolving power can be made use of. This applies to most object-glasses; they are generally made with an aperture that provides for the use of high eyepieces. They are provided with a larger numerical aperture than is required with low eyepieces.

It might be urged that it is always best to get the maximum resolution even if it is not required—but there are other properties besides resolution required by a microscope. Flatness of field is a property of importance for certain purposes. The photographer wants more than the centre of his picture to be sharp. The blood count asks for reasonable definition at the edge of the field, and so forth.

I will draw your attention to the flatness of field of a series of the very best microscope object-glasses (fig. 3). The curves show the actual focal plane over an area of the field of a No. 1 eyepiece. The low-power, small-aperture lenses have moderately flat fields, but as the aperture is increased the curvature of field is of such a terrible nature that it is surprising that anything is visible at the edge of the field. The anastigmat photographic lens has a field that is almost a straight line, but the $\frac{1}{12}$th oil immersion has its focus at the margin of the field of a No. 1 eyepiece farther away from the focal plane than the radius of the field of view, and is it a wonder that when opticians are asked to produce wide-angle lenses with flat fields they are discreetly silent ? The only reason why anything is visible at the edge of the field is that each part of the image is being formed by a very narrow cone of rays (fig. 3 (A, B, C)) that does not spread very rapidly into large circles of confusion.

If the full aperture of the object-glass is not filled with light, the cones of rays forming each bundle of light from the separate points of the image are so much reduced in angle that the circles of confusion are much smaller—more nearly points—and the. edge definition is vastly improved. There is here a distinct advantage in reducing the illuminating cone.

Penetration or the appearance of depth is increased in the same way as flatness of field by reducing the angle of the illuminating cone.

The veiling of the image, the reduction of contrast by glare, is also greatly reduced by low-angle illumination. This applies especially to objects mounted in water or a high-refracting medium where glare is at its worst, and glare can be noticed to a slight extent in stained objects mounted in balsam.

Visibility is, however, the most important question influenced by wide-angle illumination. Very transparent objects are almost always seen by
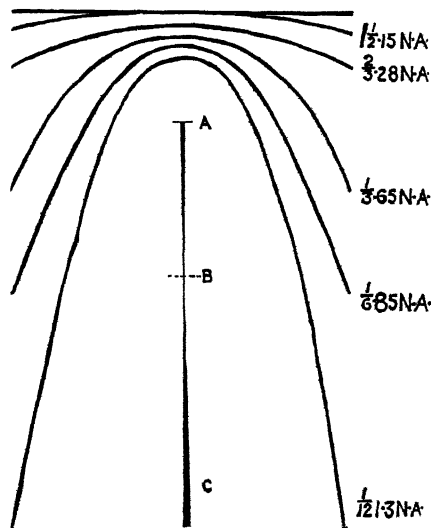
FIG. 3.

shadows and the more fully the aperture is filled, the more the angle of illumination is increased, the more the shadows are obliterated.

Much routine microscopic examination does not call for the highest possible resolution, but it does require good visibility, sharp definition, good contrast, and some degree of flatness of field and penetration.

With opaque illumination, vertical illumination or dark ground illumination the whole aperture of the object-glass is automatically filled with light. The foregoing considerations, however, suggest that there are cases where the aperture may be reduced with advantage in vertical illumination by directing a narrow beam of light through the centre of the object-glass, or in dark ground or opaque illumination by an iris diaphragm in the nosepiece.

To sum up :

A microscope is used for many purposes. Certain different qualities are

required for each purpose, and from the foregoing remarks the following general results seem to emerge :

For the greatest resolution the whole aperture of the object-glass must be evenly filled with light. To do this most satisfactorily a perfectly corrected condenser and a small source of light are required. An Abbe condenser with a large source of light is a moderately satisfactory substitute if the very highest resolution is not required, but in both cases the light should be centred both as regards the condenser itself and the way it is directed into the condenser, and the Abbe condenser should never be focused above the object.

With low-power eyepieces the aperture should not be completely filled with light, the best method being to focus the condenser approximately upon the object and reduce its aperture with the iris diaphragm. The shape of the illuminant does not influence the even distribution of the light when the condenser is near its focus.

With objects of low visibility, with objects in water, air, or mounting medium of high refractive index, the lowest aperture in the condenser that will show the desired detail should be used. For photography with low-power eyepieces the aperture should be as small as will depict the required detail.

II.—CELLULOID IMPRESSIONS OF THE SURFACE STRUCTURE 535. 826. OF ANIMAL FIBRES.

By J. MANBY, F.R.P.S.

(Photographic Dept., The University, Leeds.)

HARDY's celluloid impression method for revealing the surface structure of heavily pigmented or medullated animal fibres * has proved of great value to zoologists and textile scientists.

Although rather laborious when a number of impressions have to be made, it is quite satisfactory for wool fibres and certain hairs.

Modifications are necessary, however, when impressions are required of very delicate or short, heavily pigmented hairs, bristly hairs which twist along their length, quills, spines, and certainly where the surface structure of the tips and roots must be seen. Considerable labour has been expended in finding suitable modifications, and it is hoped that they will save the time of other workers.

Wool Fibres.

To prepare wool-fibre impressions the author prefers to attach the fibre to each end of the slide with wax, as Dr. Hardy does, allowing the fibre to touch the slide along its length, and simply to place upon the fibre a drop of 3 p.c. celluloid in amyl acetate and leave until the solvent has evaporated, cut the fibre at its ends, and tear it out. The slide is then inverted to examine the impression, using a $\frac{1}{6}$-inch objective. If a $\frac{1}{4}$-inch lens is preferred the fibre should be mounted upon a cover-glass of suitable length and thickness.

Preparations by this method can be made very speedily, and although, as in Hardy's method, the surface through which the fibre has been torn will show a fissure, the celluloid impression of this surface will be complete for at least parts of its length. An illustration of this fact is given on pl. II, fig. c.

Bristly Hairs.

For impressions of strong or bristly hairs which twist along their length it is preferred to lay the hair upon a slide, place upon it a drop of 1 p.c.

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celluloid in amyl acetate, and mount with a celluloid cover-glass. (The thinnest obtainable first quality Kodaloid, from Messrs. Kodak, Ltd., Kingsway, London, is very suitable. This is a cellulose nitrate film, about 0·003 inch in thickness.) The cover-glass, cut to a suitable size, should be pressed down with the finger, which flattens out the twists on the hair. It is necessary with some hairs to apply pressure with another slide and a cornet's forceps while the medium is drying. Those mounts should be left overnight, the celluloid peeled from the slide, the hair torn out, and the " cover-glass " containing the impression mounted with paper-binders at its edges upon a slide, impression side down. This has proved a very simple and satisfactory method.

Quills and Spines.

Impressions of the scale structure of quills and spines are most easily made by putting a drop or two of 3 p.c. celluloid solution on a small sheet of the celluloid, placing the quill upon the pool, and, when dry, tearing off the celluloid sheet, which is then mounted as above, impression side down.

Short, Delicate Hairs.

Considerable difficulty was at first experienced in making satisfactory impressions of very short or delicate hairs of low tensile strength. It is now quite possible to prepare celluloid impressions of such minute hairs, using, where necessary, a magnifying lens.

Although the one given first is now preferred, the following two methods have proved completely satisfactory for revealing the scale structure of fine hairs, such as those of certain bats, and the fur hairs of many mammals, including the platypus, the coat of which is being thoroughly investigated by Dr. Wildman, of our Zoological Department, and the author.

For the first method the following solution is required :

.	Gelatin	..	..	..	..	..	5 grms.
	Water	..	..	..	..	..	100 c.c.

(Dissolve by heat, and add a crystal of thymol, or 1 p.c. carbolic acid as preservative. Glycerine should not be added.)

A small quantity of the jelly is poured over a slide, which is then placed in an upright position to drain and dry. When the film of gelatin is quite dry a drop of cold water is spread out upon the surface and the slender hairs are arranged side by side in the water.* The slide is again put aside to drain and dry thoroughly, when it will be found that the hairs are adhering to the jelly. A celluloid cover-glass of suitable size is now mounted in 1 p.c. celluloid in amyl acetate, or amyl acetate alone, over the hairs and left

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* A lantern plate which has been " fixed," washed, and dried may be cut into three slides having the ideal gelatin coating.

d.

c.

b.

a.
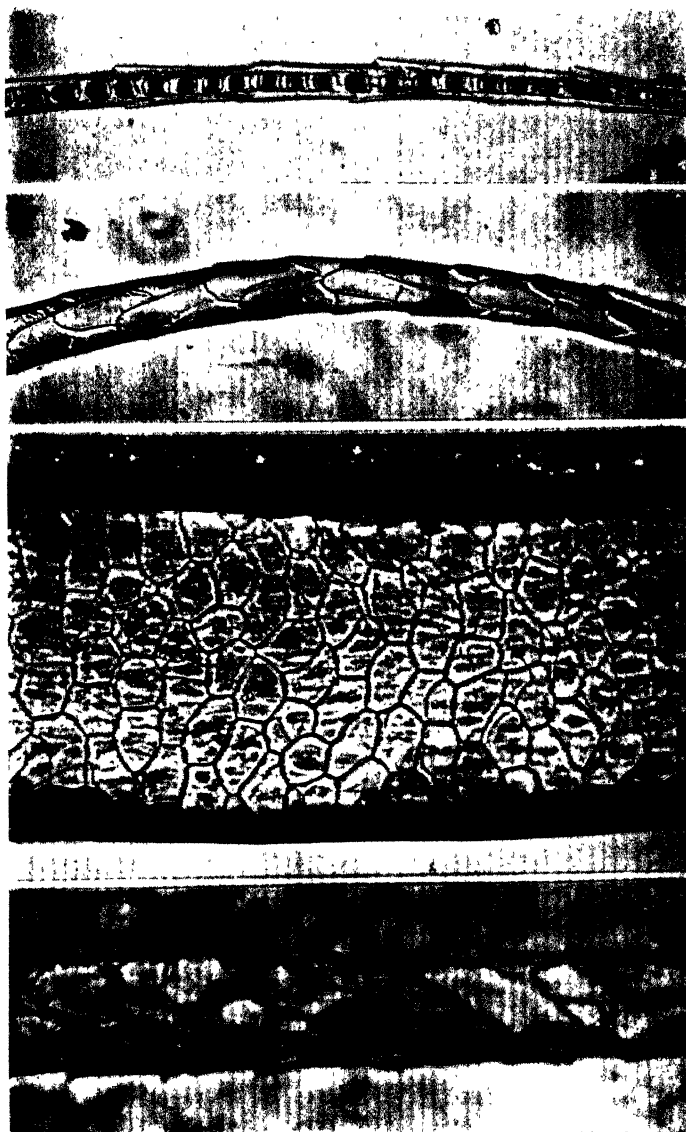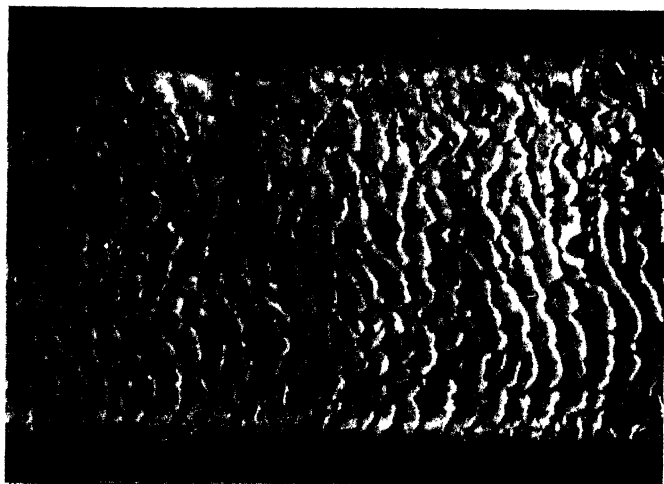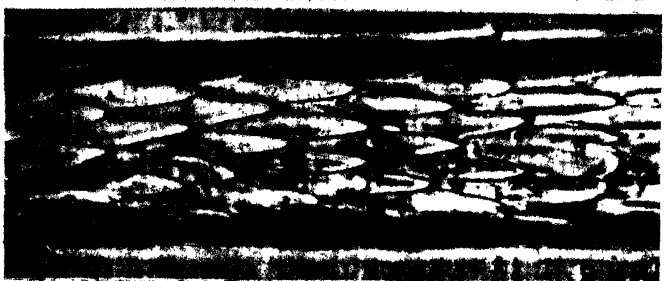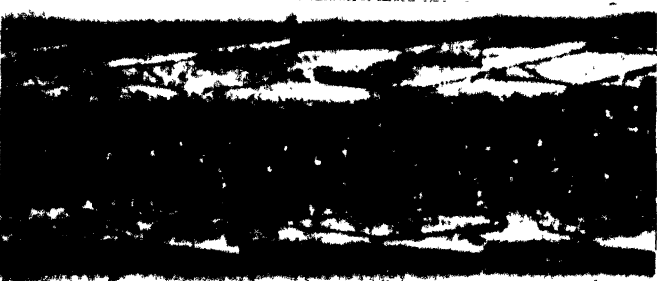
overnight. The small celluloid sheet is then peeled off, and mounted upon another slide, impression side down. The minute hairs will remain attached to the gelatin-covered slide, and celluloid impressions of their upper surfaces will be found upon the celluloid cover.

In the second method two glass cover-glasses are taken and placed, with the hairs in the desired position, as shown in the sketch, fig. 1, a drop of 1 p.c. celluloid in amyl acetate is placed upon the hairs and, when dry, the uppermost cover-glass is pulled off (with a vertical motion from the lower cover-glass as it lies upon the bench), leaving impressions of the tip portions of the hairs on the under cover-glass. It is thus possible to overcome the difficulty of " tearing out " such fine hairs, because at the junction of the cover-glasses the celluloid remains moist for some time after the exposed medium has become dry.

To prepare impressions of the root ends of the hairs it is best to take a number of similar hairs and place them so that the root ends lie upon the

Hair tips.   Uppermost cover-glass.
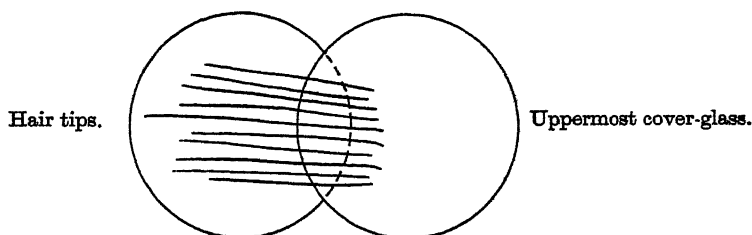
FIG. 1.

lower cover-glass. It is very difficult to remove the hairs from the upper cover-glass, because of the ridge of hard celluloid at its edge.

Previous to these methods for very fine hairs, the author employed the less satisfactory one of placing the hairs, projecting a little, on small sheets of the celluloid and applying amyl acetate alone or 1 p.c. celluloid solution, allowing to dry, and tearing out the hairs. This procedure was given up, however, because of the difficulty of removing the slender hairs from the celluloid.

By selecting the most suitable of these methods, it is possible to make a celluloid impression of the surface structure of any hair, and Dr. Wildman and others have found them of real value.

Similar methods may be employed for impressions for microscopical examination of skin (finger-prints), fossils, gramophone records, and other thick or opaque objects. Many microscopic objects, including bacteria and blood cells, may be " cast " in celluloid.

For the examination or photography of white, non-medullated fibres, and for fibres which are lightly pigmented or have a slender medulla, it is preferred to mount the fibre by the author's previous method.* This method

* *J. Text. Inst.*, Vol. 23, T5.

saves the trouble of making impressions and gives a very satisfactory microscopic image which can be readily photographed.

DESCRIPTION OF PLATES.

PLATE I.

a.—Leicester Wool.　Impression × 500.
b.—Mouflon Wool, near root.　Impression × 200.
c. and *d.*—*Ornithorynchus anatinus* fur hairs, near root.　× 500.
　　　　c.　Impression.
　　　　d.　Actual, more slender hair.

PLATE II.

Mink Hair × 500.

a.—Impression near middle of length.　(Black hair with broad medulla.)
b.—Impression, near root.
c.—Impression, near root.　(Showing fissure through which hair was removed.)
d.—Actual hair (a little farther from root end).

III.—NOTES ON THE PRACTICE OF FIXATION FOR ANIMAL 535.826.1
TISSUES.

By Peter Gray, Ph.D., A.R.C.S.

(Lecturer in Vertebrate Embryology in the Department of Zoology,
University of Edinburgh).

Introduction.

There has been so much written recently upon the Theory of Fixation
that the perfectly distinct art of its practice is in danger of becoming lost in
a fog of technicalities. Moreover, the general zoologist should have to-day
at his disposal some fifty fixative solutions if he is to be prepared to submit
any material he receives to the best possible treatment. Many of these
solutions—far more than are generally realized—are unstable and should
therefore be freshly prepared before use. This usually results either in the
wastage of large quantities of solution, or, should this latter be stable, in
the accumulation of a large number of bottles upon the laboratory shelves.

The present study is an endeavour not only to guide the choice of a
fixative but to put forward a method whereby wastage may be avoided.

The Functions of the Fixative.

It may be stated, from the practical point of view, that the worker may
require one or more of three functions from the solution employed. These
functions are :

(1) That the material shall be preserved in the shape it had before fixation.
(2) That the nuclear elements of the material shall be preserved.
(3) That the cytological elements of the material shall be preserved.

Each of these three functions will be discussed in the order given.

1. *The Preservation of External Form.*—The loss of external form on the
part of fixed material is brought about either by the contraction of the
animal or by unequal diffusion leading to the distortion of cavities.

The contraction of the animal may in many cases be prevented by pre-
liminary narcotization, which is often essential in the case of invertebrates.
Moreover, in such animals as the Rotifera and Polyzoa the fluid employed
must contain an " immobilizing agent " if the external form is to be success-
fully preserved.

There appear to-day to be only three immobolizing agents of general value—a temperature between 60° C. and 75° C., osmic acid, and, to a far less extent, mixtures of acetic with chromic and picric acid.

The first of these agents—heat—may obviously be added to any known fixative. In the vast majority of cases both cytological and histological detail is ruined by its use, yet it remains of great value for many of the marine hydrozoa which are subsequently intended to serve as whole mounts or museum preparations. Osmic acid is unquestionably the most useful immobilizing agent which has yet been discovered, in that cytological—but not always nuclear—detail is well preserved by its use, while many of the lower invertebrates retain far more of their original transparency with this than with any other fixative.

It is vertebrate embryological material which suffers most from distortion, and the preservation of its external form is best accomplished by solutions containing formaldehyde, potassium bichromate, or Müller (potassium bichromate plus sodium sulphate). This last is usually taken to be identical in its action with pure bichromate—a statement which, though undoubtedly true from the chemical point of view, is in the present writer's experience untrue, in that the mixture produces far less distortion than the pure bichromate. It must be made quite clear that " distortion " is here used to indicate a change which produces a definite change of " shape." Uniform " shrinkage " and " swelling " without an accompanying change of " shape " are perfectly distinct processes; potassium bichromate (*inter alia*) produces the former and formaldehyde the latter, so that combinations of these two, or of the latter with Müller, are indicated for the preservation of the external form of delicate mammalian tissues.

2. *The Preservation of Nuclear Detail.*—Much which must be here omitted has been written upon the chemical aspect of this problem. From the practical point of view the question is bound up with that of penetration. The most universally employed penetrating agent is acetic acid, whose swelling action is usually restrained by the addition of picric or chromic acids. It should be pointed out that penetration and distortion are usually produced by the same agents, and under this heading must be included many of the ether-alcohol fixatives. The distorting action of these upon whole animals is to a certain extent restrained by the addition of corrosive sublimate. In general, however, it is impossible to obtain the finer details of nuclear fixation in entire animals or organs whose shape it is desired to preserve.

3. *The Preservation of Cytological Detail.*—This is largely a question of the chemical or physical coagulation of relatively large masses of protoplasm. This coagulation is brought about by various reagents, e.g. alcohol, compounds of chromium, copper, osmium and mercury, picric acid and formaldehyde. The choice of the agent employed must be governed by the particular detail which it is desired to preserve, and by the effect which the chosen agent is likely to exert upon the shape and size of the object. The question of transparency should also be included here. Many objects may very con-

veniently be permanently preserved in neutral formol, where they will retain much of their original transparency ; this transparency is usually destroyed by previous fixation in any fluid other than weak osmic acid solutions.

THE CHOICE OF A FIXATIVE.

The simplest way to approach this problem is to classify known fixatives along the lines indicated in the above notes.

PRACTICAL CLASSIFICATION OF FIXATIVES.

A. *Fixatives for Highly Contractile Animals.**

1. WHEN PRESERVATION OF SHAPE IS OF PRIMARY IMPORTANCE.
   (a) *When protoplasmic detail is of secondary importance.*
   Most fixatives raised to a temperature of 60° to 75° C.

   (b) *When it is desired so far as possible to retain the original transparency.*
   Osmic acid in 0·1 p.c. to 1 p.c. aqueous solutions.

   (c) *When it is desired so far as possible to retain external form and proto-plasmic detail without reference to transparency.*
   Champy, Flemming 1, 2, and 3, Hermann. Lindsay-Johnson, Lenhossék, Maximow. Merkel, Rabl 2 and 3, vom Rath, Yocum.

2. WHERE EXTERNAL FORM IS OF SECONDARY IMPORTANCE.
   (Fixative to be selected according to other character desired as below.)

B. *Fixatives for Whole, Non-Contractile, or perfectly Narcotized Animals or Embryos or Whole Organs exceeding 5 mm. in thickness.*

1. WHEN IT IS DESIRED TO PRESERVE THE EXTERNAL FORM.
   (a) *When transparency is of primary importance.*
   4 p.c. formaldehyde in neutral aqueous solution.

   (b) *When size and shape are of primary importance.*
   (Apáthy), Bensley, Erlicki, Hoyer, Kostanecki 1 and 2, Lavdowski, Maximow, Müller, Orth, Régaud.

2. WHEN IT IS DESIRED SO FAR AS POSSIBLE TO PRESERVE BOTH SHAPE AND PROTOPLASMIC DETAIL.
   (a) *When shape is of greater importance.*
   Helly, Perenyi, Rawitz, Smith, Zenker.

   (b) *When protoplasmic detail is of greater importance.*
   Bouin, Fol, Gilson, Kohn, Mayer, Rabl 1, Schaudinn, Tellyesniczky.

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* For minute freshwater animals see the special technique described by the present writer in Journ. R. Micr. Soc. 1932, 52, pp. 370–373.

C. *Fixatives for Small Portions of Organs, or Whole Organs, or Embryos, not exceeding 5 mm. in thickness.*

1. WHEN A GENERAL PURPOSE FIXATIVE IS REQUIRED.

Bouin, Carleton, Gatenby, Gerhardt, Gilson, Kohn, Mayer, Rabl 1, 2, and 3, Schaudinn.

2. WHEN PROTOPLASMIC DETAIL IS OF PRIMARY IMPORTANCE.

(a) *When nuclear fixation is specially required.*

van Beneden, Bouin-McLung, Carnoy 1 and 2, Carnoy-Lebrun, Carnoy-Sanson, Petrunkevitsch.

(b) *When cytoplasmic detail is specially required.*

Champy, Flemming (without acetic), Kolachev, Kulschitzki, Mann, Regaud, Smith.

THE PREPARATION OF THE FIXATIVE.

The majority of the fixatives included in the foregoing classification are unstable and should be freshly prepared before use. Their components, however, form stable solutions—hereafter referred to as " basal fixative solutions "—which may be stored for a considerable period of time. Very few published formulæ, however, refer to preparation from solutions, and even where this is the case, the solutions quoted are not constant throughout the whole series. It has been found possible, by dividing all the fixatives quoted into an " alcoholic " and " aqueous " series, to devise ten aqueous and two alcoholic " basal fixative solutions " which, when mixed with each other and with ordinary bench reagents, will give the whole range of formulæ quoted ; they can also, by a simple mathematical adjustment, be made to give any other fixative which is likely to be required. The ten aqueous solutions are :

Basal Fixative Solution 1.

Pure nitric acid	..	..	..	..	800 c.c.
Distilled water	..	..	..	..	200 c.c.

Basal Fixative Solution 2.

40 p.c. formaldehyde.

It is convenient to maintain this in a " neutral " condition with magnesium carbonate or borax. In no case is this essential for fixative mixtures.

Basal Fixative Solution 3.

Glacial acetic acid.

Basal Fixative Solution 4.

Chromic acid ..	..	..	..	..	20 grms.
Distilled water to make	..	..	..	1000 c.c.

This is a perfectly stable solution if prepared with freshly distilled water and stored in a chemically clean bottle.

Basal Fixative Solution 5.

Potassium bichromate	..	..	..	75 grms.
Distilled water to make	..	..	..	1000 c.c.

This solution cannot be maintained if the temperature of the laboratory falls below 10° C.

Basal Fixative Solution 6.

Potassium bichromate	..	..	..	75 grms.
Sodium sulphate	..	..	..	30 grms.
Distilled water to make	..	..	..	1000 c.c.

Basal Fixative Solution 7.

Mercuric chloride	..	..	..	70 grms.
Water ..	..	..	..	1000 c.c.

This solution should be prepared with freshly distilled water at a temperature of about 60° C. ; a certain amount of $HgCl_2$ may crystallize out upon cooling. This is the " saturated solution of corrosive sublimate " referred to in the preparation of many fixatives. Where the original formulæ quote the weight of the dry salt, the " Basal Fixative Solution 7 " is assumed to contain 7 p.c., which will be true at temperatures of 15° C. and over. The loss (about 0·08 p.c. per degree Centigrade) occasioned by probable falls in temperature may for all practical purposes be ignored.

Basal Fixative Solution 8.

Saturated solution of picric acid in distilled water.

The variation of this solution over a normal range of temperature may be ignored. It is simplest to start with a 3-cm. layer of picric on the bottom of a litre bottle filled with water and to fill up with distilled water after each extraction ; if the solution is used frequently it is better to keep two bottles, extracting from and filling up each alternately.

Basal Fixative Solution 9.

Commercial " platinum chloride "	..	..	1 grm.
Distilled water	..	..	..	50 c.c.

This solution is stable if prepared with freshly distilled water and stored in a chemically clean " amber " glass bottle.

Basal Fixative Solution 10.

Osmic acid	..	..	..	..	1 grm.
0·013 p.c. potassium perman. sol.	..	...	50 c.c.

TABLE I.

TABLE FOR THE PREPARATION OF FIXATIVES FROM BASAL FIXATIVE SOLUTIONS.

Aqueous Fixatives.	Basal Fixative Solutions.										Water.	95 p.c. Alcohol.	Other Additions.
	1	2	3	4	5	6	7	8	9	10			
APÁTHY	15	30	—	—	—	—	—	—	—	—	65	—	—
BENSLEY	—	11	—	—	30	70	—	—	—	—	—	—	—
BOUIN	—	25	5	—	—	—	75	—	—	—	—	—	—
BOUIN-McLUNG	—	25	5	—	—	—	75	—	—	—	—	—	1 gram urea
CARLETON	—	10	—	—	—	90	—	—	—	—	—	—	—
CHAMPY	—	—	—	20	16	—	—	—	22		33	—	—
ERLICKI	—	—	—	—	33	—	—	—	—	—	67	—	1 gram CuSO$_4$
FLEMMING													
1. Chrome acetic	—	—	0·1	12·5	—	—	—	—	—	—	88	—	—
2. " Weak "	—	—	0·1	12·5	—	—	—	—	—	5	83	—	—
3. " Strong "	—	—	5	38	—	—	—	—	—	20	38	—	—
4. " Without acetic "	—	—	—	40	—	—	—	—	—	21	40	—	—
FOL	—	—	—	13	—	—	—	10	—	—	78	—	—
GERHARDT	—	25	2·5	13	—	—	25	—	—	—	35	—	—
GILSON	1·5	—	0·4	—	—	—	35	—	—	—	50	7	—
HELLY	—	5	—	—	30	70	—	—	—	—	—	—	—
HERMANN	—	—	5	—	—	—	—	38	2		38	—	—
HILL	4·75	—	—	—	—	—	95	—	2		—	—	—
HOYER	—	—	—	27	—	30	—	—	—	—	44	—	—
KLEINENBERG	—	—	—	—	—	—	100	—	—	—	—	—	2 c.c. H$_2$SO$_4$
KOHN	—	—	5	—	70	—	20	—	—	—	10	—	—
KOLATCHEV	—	—	—	20	—	18	—	—	—	20	42	—	—
KOSTANECKI, 1	4	—	—	—	—	—	50	—	—	—	46	—	—
,, 2	4	—	—	—	—	—	33	—	—	—	29	33	—
KULSCHITZKI	—	—	2	—	27	—	4	—	—	—	21	50	—
LAVDOWSKI, 1	—	—	1	—	—	50	2	—	—	—	45	—	—
,, 2	—	10	2	—	—	—	—	—	—	—	60	30	—
LENHOSSÉK	—	—	2·5	—	—	—	40	—	25	—	35	—	—
LINDSAY-JOHNSON	—	—	5	—	22	—	—	7·5	—	10	56	—	—
MANN	—	—	—	—	—	—	50	—	—	25	25	—	0·75 gms. NaCl.
MAXIMOW, 1	—	9	—	—	—	30	—	—	—	—	60	—	—
,, 2	—	10	—	—	—	30	—	—	—	11	60	—	—
MAYER	5	—	—	—	—	—	100	—	—	—	—	—	—
MERKEL	—	—	—	7	—	—	—	7	—	—	90	—	—
MULLER	—	—	—	—	—	30	—	—	—	—	60	—	—
ORTH	—	—	—	—	—	33	—	10	—	—	66	—	—
PERENYI	5	—	—	7·5	—	—	—	—	—	—	59	30	—
RABL—													
1. Picro-sublim.	—	—	—	—	—	—	25	25	—	—	50	—	—
2. Plat. sublim.	—	—	—	—	—	—	25	—	12·5	—	63	—	—
3. Plat. picric.	—	—	—	—	—	—	20	10	—	—	75	—	—
VOM RATH	—	—	1	—	—	—	100	—	—	6	—	—	—
RAWITZ	1	—	—	40	—	—	20	—	—	—	40	—	—
REGAUD	—	20	—	—	32	—	—	—	—	—	48	—	—
SCHAUDINN	—	—	5	—	—	66	—	—	—	—	—	33	—
SMITH	—	5	2·5	—	13	—	—	—	—	—	80	—	—
TELLYESNICKY	—	—	5	—	40	—	—	—	—	—	60	—	—
ZENKER	—	—	5	—	—	30	70	—	—	—	—	—	—

TABLE I.—*continued.*

Alcoholic Fixatives.	1	2	3	11	12	Chloroform.	Water.	Absolute Alcohol.	Other Additions.
Van Beneden	—	—	50	—	—	—	—	50	—
Carnoy, 1	—	—	25	—	—	—	—	75	—
,, 2	—	—	30	—	—	30	—	30	—
Carnoy-Lebrun	—	—	30	—	—	30	—	30	Saturate with HgCl₂
Carnoy-Sanson	—	—	5	—	—	30	—	65	Ditto
Duboscq-Brasil	—	26	6·5	45	—	—	22	—	—
Orlmacher	—	—	5	—	—	15	—	80	Saturate with HgCl₂
Petrunkevitsch	2	—	17	—	—	—	50	38	Ditto
Yocum	—	5	20	—	55	—	—	—	20 c.c. ether

This solution is absolutely stable if stored in a chemically clean bottle which has been previously rinsed in the permanganate solution. This latter may be conveniently prepared by dissolving 0·01 grm. of permanganate in 750 c.c. of freshly distilled water. This percentage of permanganate does not appear to have any effect upon the action of the osmic acid.

The two alcoholic solutions are :

Basal Fixative Solution 11.

> Dry picric acid .. .. 10 grms.
> 95 p.c. alcohol to make .. .. .. 1000 c.c.

Basal Fixative Solution 12.

> Dry picric acid .. .. 10 grms.
> Mercuric chloride .. .. 10 grms.
> 95 p.c. alcohol to make .. .. .. 1000 c.c.

Almost any recorded fixative may be prepared from this series with the addition of water, alcohol, ether, and chloroform. Before preparation the formula must be reduced to a " percentage composition." The percentage of any one constituent is given by the formula

$$C = \frac{W \times 100}{T}$$

Where C is the percentage of constituent, W the weight or volume, and T the total volume of fixative given by the original formula. A further very simple calculation gives the volume of basal fixative solution which contains this weight of constituent ; the requisite volumes of basal fixatives are added to each other and made up to a hundred with distilled water.

In the table are shown the figures for the preparation of the more usually employed fixatives. These figures have been adjusted to give approximately 100 c.c. in reasonable whole numbers, the errors thus introduced being negligible from the practical point of view.

597 :
639. 389.

IV.—THE OTOLITHS OF EIGHT EELS OF THE FOIBA.

By Prof. A. GANDOLFI HORNYOLD, D.Sc., F.Z.S., F.R.M.S.

(Read March 15th, 1933.)

TWO PLATES.

PROF. MASSIMO SELLA, Co-director of the Instituto Italo-Germanico di Biologia Marina of Rovigno d'Istria, very kindly gave me some eels to study, preserved in spirit, which had been caught in the Foiba at Pisino in the months of June and July, 1931. The Foiba disappears underground at Pisino, and its underground course has not yet been studied. The eels measured from 15 to 77 cm., and there is no doubt that such small eels can come up from the sea, even though the river is subterranean. Professor Sella carried out a most interesting experiment in the Timavo, another small river of the Carso. He marked a large number of silver eels by amputating part of the tail, and released them at San Canziano, where the river disappears underground. Many of the marked eels were recaptured at the mouth of the Timavo, near San Giovanni di Duino. The distance in a straight line is 43 km., of which 40 are underground ; but Professor Sella estimates the course of the underground river at some 50 km. Some eels did this distance in fifty-five days, and others took up to two years.

The otoliths of the eels from the Foiba were mostly very opaque, and the zones were indistinctly marked. As I also noticed various irregular forms, I preferred to keep them for a morphological study. I thank Professor Sella for his kind hospitality, as also for the eels.

The following table gives the length, weight, number of zones of the scales, and the dimensions of the saccular otoliths.

Length cm.	Weight gr.	Number of zones of scales.	Dimensions of the otoliths. mm.
77	920	6 I	4 × 2·5
65	490	4 III	3·5 × 2
61	390	4 II	3·5 × 2·5
60	415	4 II	3 × 2
45	150	3 III	2·7 × 1·9
35	75	3 I	2 × 1·5
33	80	2 III	2 × 1·5
33	70	2 III	2·2 × 1·6

All were yellow females and, as in my other papers on the eel, the Roman figures I, II, and III indicate that the eels had few, a fair number, or many scales with the maximum number of zones. The dimensions of the right and left otoliths of all the eight eels were the same.
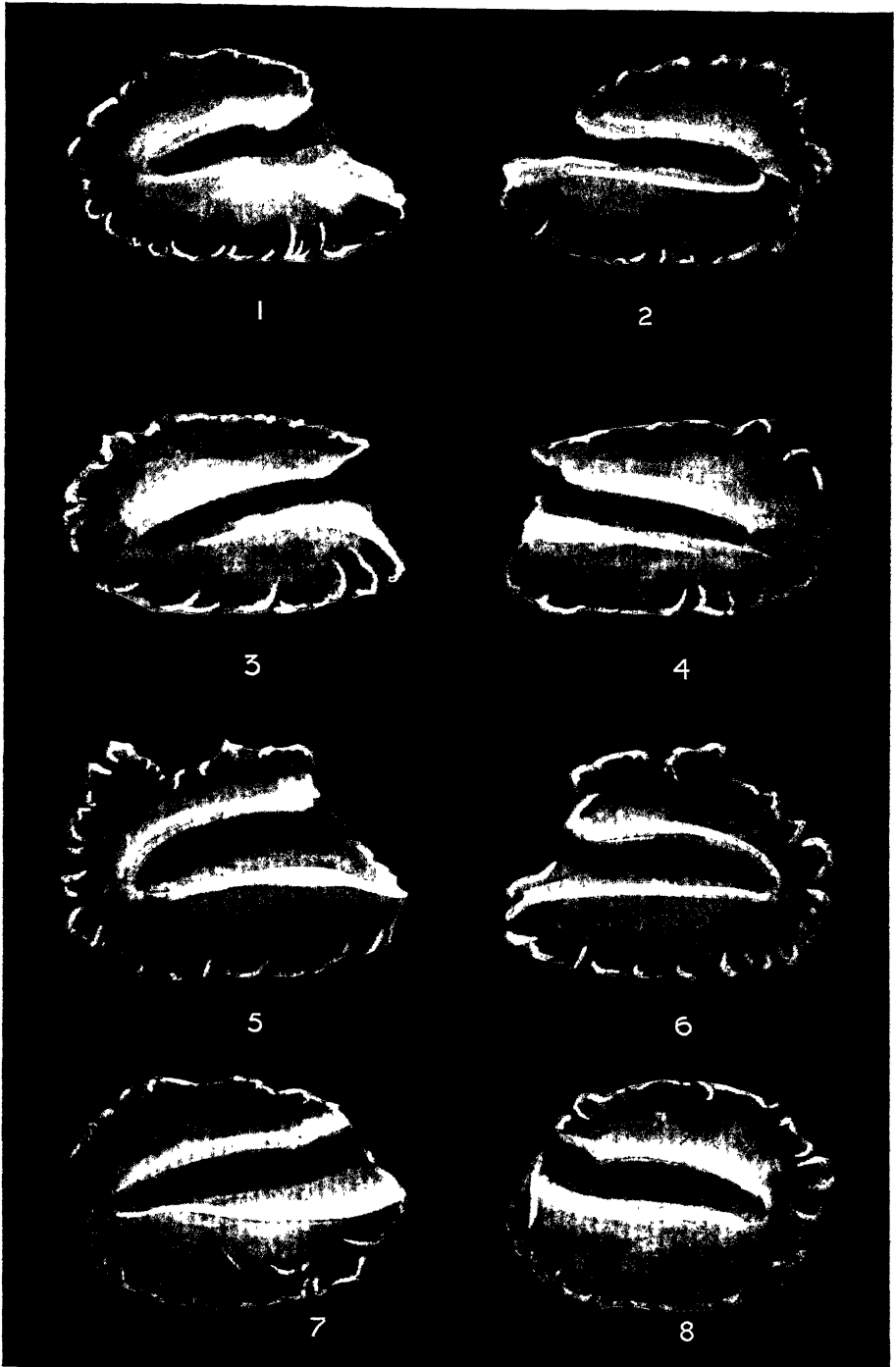
The drawings were made by Monsieur Fernand Angel, of the Musée National d'Histoire Naturelle of Paris, and I thank him for all the trouble he took to render the otoliths so perfectly. The enlargement varied from × 15 to × 30. I chose the eight otoliths which had the most irregular forms, but most of the otoliths were more or less irregular, and most of them had neither antirostrum nor excisure. The scales were quite regular, and the number of zones was rather small for the size of the eels.

The left otolith of the 77 cm. eel (fig. 1) is elongated, the dorsal rim is curved and slightly indentated towards the posterior rim, the ventral rim is straight and indentated towards the posterior rim. The posterior rim ends in a rounded protuberance, and below it, divided by a notch, is a small flattened protuberance with a slight notch. The rostrum is very large and obtuse. There is no antirostrum nor excisure, and the deep, straight, undivided sulcus opens out very widely on to the frontal rim, covering the greater part of it. The sulcus ends rounded at about three-quarters of the length of the otolith.

The right otolith (fig. 2) is a little less elongated, the dorsal rim is curved and deeply serrated, the ventral rim is straight without indentations. Near the rostrum there is a fairly deep notch. The posterior rim is flattened with an irregular protuberance. There is no antirostrum nor excisure, and the rostrum is flattened and divided by a notch. The wide, straight, undivided sulcus opens out widely on to the dorsal side of the rostrum, ending rounded at about five-sixths of the length of the otolith. A shallow narrow channel seems to continue as far as the posterior rim and ends below the irregular protuberance.

The left otolith of the 65 cm. eel (fig. 3) is very elongated, the dorsal rim is slightly curved and indentated towards the posterior rim, the ventral rim is straight with few indentations. The posterior rim is rounded and indentated towards the dorsal rim. The antirostrum is a small, rather blunt point ; an excisure is present, and the rostrum forms a blunt point. The wide, deep, undivided, oblique sulcus opens out widely on to the frontal rim, covering the greater part of it. The sulcus ends in a point at about three-quarters of the length of the otolith.

The right otolith (fig. 4) is also very elongated, both the dorsal and ventral rims are straight with few indentations, and the posterior rim is rounded. The antirostrum forms a small sharp point, an excisure is present, and the rostrum is fairly large and rounded. The wide, deep, undivided, oblique sulcus opens out widely on to the dorsal part of the rostrum, but the opening is not as wide as in the left otolith. The sulcus ends rounded at about two-thirds of the length of the otolith. As was the case in the right otolith of the 77 cm. eel (fig. 2), a shallow channel continues as far as the posterior rim. Here, however, the channel widens out towards the posterior rim.

The left otolith of the 61 cm. eel (fig. 5) is elongated, both the dorsal and ventral rims would be nearly straight were it not for the very large indentations, which produce a serrated appearance. The posterior rim is rounded

and serrated. The antirostrum and excisure are just indicated, and the rostrum is obtuse and indentated on the dorsal side. The very wide, deep, undivided, slightly curved sulcus opens out very widely on to the dorsal part of the rostrum. The sulcus ends rounded at about three-quarters of the length of the otolith.

The right otolith (fig. 6) is less elongated, the dorsal rim is curved, the ventral straight, and the posterior rim is rounded. All are more or less serrated, and especially so the dorsal and posterior rim. The antirostrum forms a small, fairly sharp point, an excisure is present, and the rostrum is large, flattened, and divided by two notches, thus forming three small protuberances. The large, wide, undivided, straight sulcus opens out widely on to the dorsal part of the rostrum, and ends rounded at about five-sixths of the length of the otolith.

The left otolith of the 60 cm. eel (fig. 7) is elongated, both the dorsal and ventral rims are curved, and the posterior rim is rounded. The indentations are few and small, except for one large one on the posterior rim. There is neither antirostrum nor excisure, and the rostrum is a rounded protuberance. The very wide, deep, straight, undivided sulcus opens out widely on to the dorsal part of the rostrum. It tapers down gradually and ends indistinctly on the posterior rim in the large indentation.

The right otolith (fig. 8) is less elongated, the dorsal and ventral rims are slightly curved, and the posterior rim is rounded and serrated. There are a few small indentations on the dorsal and ventral rims. The antirostrum is small, flattened and divided by a notch into two protuberances. An excisure is barely indicated and the rostrum is obtuse. The wide, deep, slightly curved sulcus opens out on the dorsal part part of the rostrum much less widely than in the left otolith. The sulcus ends rounded at about five-sixths of the length of the otolith.

The left otolith (fig. 9) of the 45 cm. eel is ovate, both the dorsal and ventral rims are curved, and the posterior rim ends in a point. All are slightly serrated. There is no antirostrum nor excisure, and the rostrum is large and rounded. The wide, curved, undivided sulcus opens out on the dorsal part of the rostrum, but owing to a very gradual sloping down, the contour on the ventral side is indistinct. The sulcus ends rounded, but not very distinctly, at about three-quarters of the length of the otolith.

The right otolith (fig. 10) is ovate, the dorsal side is very curved and serrated, the ventral rim is nearly straight and serrated towards the rostrum. The posterior rim is rounded and serrated towards the dorsal rim. There is no antirostrum nor excisure, and the rostrum is fairly large and obtuse. The deep, curved, undivided, narrow sulcus opens out widely on the frontal rim, covering the greater part of it. The sulcus ends rounded at about five-sixths of the length of the otolith.

The left otolith of the 35 cm. eel (fig. 11) is ovate, the dorsal rim is straight and the ventral curved. The posterior rim is rounded with a small protuberance near the dorsal rim. There are few indentations. The anti-

rostrum is large and forms a blunt point, an excisure is present, and the rostrum is large and rounded. The straight, deep, undivided sulcus opens out widely on the frontal rim and ends rounded at about three-quarters of the length of the otolith.

The right otolith (fig. 12) is elongated and has a rectangular form, the dorsal rim is slightly curved and the ventral is straight. Both have few indentations. The posterior rim is flattened with few indentations. Both antirostrum and rostrum are rounded and an excisure is present. The narrow, straight, deep, undivided sulcus opens out widely on to the frontal rim, and ends rounded at about two-thirds of the length of the otolith.

The left otolith of the 33 cm. and 80 gr. eel (fig. 13) is ovate, both the dorsal and ventral rims are curved, and the dorsal rim is serrated towards the posterior rim. The frontal rim is also serrated and the ventral rim has few indentations. The posterior rim has a small flattened protuberance near the dorsal rim, and is rounded with a large notch a little below the protuberance. The antirostrum is rounded and serrated, an excisure is present, and the rostrum ends in a curved protuberance and is serrated on the dorsal side. The deep, straight, undivided sulcus opens out on to the dorsal side of the rostrum, and ends rounded at about five-sixths of the length of the otolith. An interrupted narrow channel reaches the posterior rim in the notch.

The right otolith (fig. 14) is ovate, both the dorsal and ventral rims are nearly straight, and the posterior rim is rounded and indentated. The antirostrum is rounded, an excisure is present, and the rostrum ends in a small blunt point. The straight, deep, undivided sulcus opens out widely on to the dorsal part of the rostrum, and ends rounded at about two-thirds the length of the otolith.

The left otolith of the 33 cm. and 70 gr. eel (fig. 15) is ovate, the dorsal and ventral rims are slightly curved with few indentations. The posterior rim is rounded with a protuberance near the dorsal rim; there are some indentations. There is no antirostrum nor excisure, and the rostrum is obtuse. The curved, deep, undivided sulcus opens out on to the dorsal side of the rostrum and ends rounded at about three-quarters of the length of the otolith.

The right otolith (fig. 16) is more elongated, both the dorsal and ventral rims are curved, and the posterior rim ends in a protuberance near the dorsal rim. There is no antirostrum nor excisure, and the rostrum is rounded. The wide, straight, undivided sulcus opens out on the dorsal side of the rostrum, and ends rounded at about two-thirds of the length of the otolith.

If we compare the sixteen figures representing the left and right otoliths of eight eels measuring 33–77 cm. we can observe that no two otoliths, even those from the same eel, are identical, but all vary more or less, either in their form or in that of the sulcus, or in both. In many cases the rims are more or less serrated, and this is usually due to crystallizations of calcite. The best examples are the otoliths of the 61 cm. eel (figs. 5 and 6). Here both otoliths are deeply serrated on account of the numerous crystalliza-

tions. The left otoliths of the 60 and 45 cm. eels (figs. 7 and 9) have comparatively few crystallizations, but the right otoliths have many and the rims are deeply serrated (figs. 8 and 10). In some cases the irregularities are more or less similar in both otoliths, as in the cases of the absence of the rostrum of those of the 77, 60 and 33 cm. eels (figs. 1, 2, 7, 8, 15, and 16). In all these cases the form of the rostrum, as also that of the sulcus, differs more or less. Another case is that of the very elongated form of the otoliths of the 65 cm. eel (figs. 3 and 4). Here also the form of the antirostrum and rostrum differs, as also the sulcus. The form of the left otolith of the 35 cm. eel is ovate, and that of the right otolith is more or less rectangular. In both otoliths, however, the antirostrum, rostrum and sulcus differ (figs. 11 and 12).

It is the first time that I have seen a divided antirostrum, like that of the right otolith of the 60 cm. eel (fig. 8), or a serrated one, as that of the left otolith of the 33 cm. and 80 gr. eel (fig. 13). The rostrum of the right otolith of the 77 cm. eel is flattened and divided by a notch (fig. 2). The rostrum of the right otolith of the 61 cm. eel is also flattened, but is divided by two notches (fig. 6). The rostrum of the left otolith of the 33 cm. and 80 gr. eel (fig. 13) is most curious ; it ends in a curved protuberance and is serrated on the dorsal rim. The rostrum of the right otolith, which forms a small blunt point, is also curious (fig. 12).

The posterior rim can end in protuberances of more or less curious form, as in figs. 2, 13, and 15, representing the right otoliths of the 77 cm. and the left otoliths of the two 33 cm. eels.

The sulcus can be very wide as in figs. 5, 7, 11, and 16, narrow as fig. 10, with an indistinct contour as fig. 9, and it can be straight, curved, or oblique (figs. 1, 10, and 3). The sulcus of the right otoliths of the 77 and 65 cm. eels and the left one of the 60-cm. eel end apparently more or less far from the posterior rim (figs. 2, 4, and 7). On examining more closely one sees that a more or less shallow channel continues as far as the posterior rim. In the case of the left otolith of the 33 cm. and 80 gr. eel, the shallow channel is visible on the posterior rim, but is interrupted before reaching the ending of the sulcus (fig. 13).

It is the first time that the otoliths of eels from a river with a partly subterranean course have been studied, and they present as much variation as to form and sulcus as the otoliths of eels from other rivers.

In no case was the sulcus divided into ostium and cauda, and this paper shows again that even quite small eels may have otoliths of very irregular form.

V.—A SIMPLE BLOCK TRIMMER FOR THE CAMBRIDGE ROCKING 535. 826. 3. MICROTOME.

By DOUGLAS P. WILSON, M.Sc.

(Read March 15th, 1933.)

ONE TEXT-FIGURE.

WHILE most experienced microtomists are able without the aid of any special apparatus to trim a paraffin block rapidly and with sufficient accuracy to ensure a reasonably straight ribbon, the novice generally finds it difficult. Even skilled workers will occasionally have trouble with very small blocks. A block trimmer, on the other hand, is a moderately expensive item not found

FIG. 1.
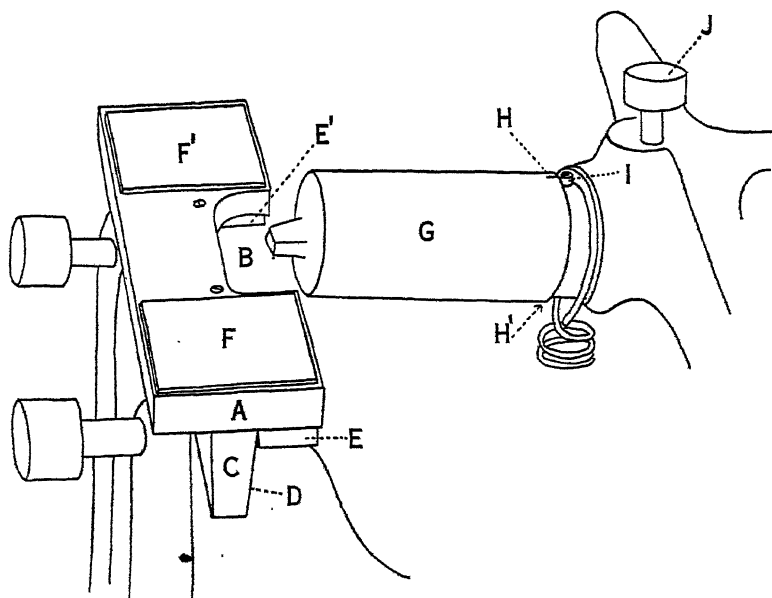
in all laboratories. Thus the following description of a very simple and almost costless instrument devised by the writer and constantly used by him when trimming small blocks for the Cambridge Rocking Microtome may be of interest to others.

A piece of wood A (see fig. 1), 3½ inches by 1¼ inches by ¼ inch, has a slot B about 1¼ inches long and ⅜ inch deep cut out in the middle of one side.

A strip of wood C, $3\frac{1}{2}$ inches by $\frac{1}{2}$ inch by $\frac{5}{16}$ inch, is fixed by means of glue and screws along the middle of the first piece so that it forms a ridge at right angles to it. This ridge can be inserted into the knife clamps of the microtome and fixed firmly by the clamping screws. It is necessary, however, to bevel slightly face D of this ridge to correspond with the bevel of the knife clamps on the side opposite to the screws. This is, of course, done before attaching C to A. As on the modern Cambridge Rocking Microtome the sides of the slots of the knife clamps are unequal in height, being lowest on the side nearest to the rocking arm, two small strips of wood E and E' about $\frac{1}{8}$ inch thick are glued to the under surface of A on either side of the slot B. These and the bevelling of C at D ensure that the apparatus shall rest firmly in the knife clamps with the upper surface of A horizontal. Finally, two pieces of glass F and F', $1\frac{1}{4}$ inches by 1 inch, are cut from a thick microscope slide and stuck on to the upper surface of A in the positions shown.

It is now necessary to make with great care two scratches on the object-holder G. One of these scratches is shown at H; the other is in a position exactly half-way round the back edge of the object-holder at approximately H', i.e. the imaginary line joining H and H' is a diameter of the cylinder G. Another scratch is put on top of the small stop I. The apparatus is now ready for use.

The wax block containing the object is trimmed roughly and is then stuck on to the object-holder G so that the sides which are to form the upper and lower parallel faces after trimming are as nearly as can be judged at right angles to the line HH'. The scratch H is then brought exactly against the scratch on I and the holder clamped by the screw J. An old razor or microtome knife (safety razor blades are too pliable) is laid on FF' and G is raised by means of the handle which actuates the rocking arm when cutting sections. This handle is pulled round slowly by the right hand until G is raised sufficiently for the razor, slid over the glass plates by the left hand, to shave off from the top of the block as much as may be desired. The holder is then turned until the scratch H' coincides with the scratch on I. The operation with the razor is repeated, only of course it is the other side of the block which is now cut. It will be seen that providing the scratches H and H' lie on a diameter of G and not merely on a chord, the upper and lower sides of the block will be perfectly parallel transversely * and the ribbon will be straight. As it is so important that these scratches should be in the right places it will not be out of place to describe one good method of putting them there.

The wax on the end of G is melted until it forms a plane surface. A razor edge is then pressed on to it in order to mark a straight line across its diameter. A good scratch is put on I and G slipped on to the rocking arm. A straight edge is fixed in the knife clamps. G is now rotated until the line in the wax

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* These faces, owing to the lever motion of the arm, will obviously not be parallel longitudinally. The divergence is, however, too slight to be of practical importance.

is parallel with the straight edge, and it is then clamped by screw J. Using some convenient tool the scratch H is made in perfect alignment with the scratch on I. A lens should be used in this operation. Scratch H having been made, G is turned through 180° until the line in the wax is again parallel with the straight edge and G is again clamped. Scratch H′ can now be put on in the same way as H.

In practice this method of block trimming is very rapid. When the blocks to be trimmed are small it is quicker than judging by eye. It also ensures that the ribbon will be straight from the very first and remain so to the end, or should it be slightly curved due to compression of the sections on one side more than on the other, it will straighten out perfectly when flattened.

576.311. VI.—CHROMATIC INCLUSIONS IN THE CYTOPLASM OF CELLS AFTER GAMMA RADIATION, AND CHANGES IN THE NUCLEOLUS.

By J. C. MOTTRAM.

(From the Research Laboratories of the Radium Institute, London, and the Mount Vernon Hospital, Northwood.)

(*Read March 15th*, 1933.)

FIVE TEXT-FIGURES.

IT is well known that multi-nucleated cells occur in both animal and vegetable tissues which have been subjected to X radiation, or the β and γ radiations from radium. This abnormality has been considered to be due to mitosis without cell division and to irregular migration of the chromosomes to the
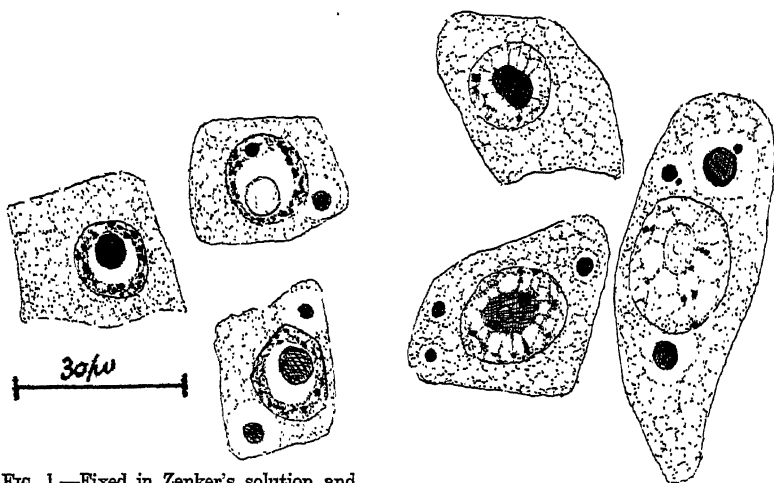
FIG. 1.—Fixed in Zenker's solution and stained by Gram's method : three cells showing vacuolation around the nucleolus and variation in nucleolar staining; in two of the cells abnormal cell inclusions are shown. The scale here given applies to all the other figures.

FIG. 2.—Fixed in Zenker's solution and stained by Gram's method. Three cells showing variation in nucleolar staining, the darkly stained one being normal; two of the cells contain cell inclusions.

centrosomes during mitosis, those arriving late not joining with the early arrivals, and thereafter forming a separate nucleus. These multi-nucleated cells may contain two or more nuclei of approximately the same size. More often the nuclei are unequal in size. Sometimes very small nuclei occur, as illustrated in fig. 4. Nevertheless they present a normal nuclear structure, except that a nucleolus is usually absent.

Multi-nucleated cells have been referred to because other bodies said to be derived from the chromosomes have been observed by Alberti and Politzer (1923) after subjecting the cornea of the salamander, and chick embryos, to radiation; also by Komuro (1924) in *Vicia faba* after X radiation, and by Levine (1929) in irradiated tissues. These bodies form cytoplasmic inclusions which consist of small droplets of chromatin surrounded by a vacuole. These observers conclude that they represent chromosomes or parts of chromosomes which have failed to migrate during mitosis, and so have become eliminated and lost in the cytoplasm.

This paper deals with the occurrence of similar bodies in the root tips of broad beans subjected to the γ radiation from radium. They are well seen in the root tips taken three days after an exposure of three hours to γ radiation from an applicator of 60 mgrms., area 4 sq. cm., screen 3 mm. of lead and 0·12 mm. silver. Such an exposure is not lethal to the root; but suffices temporarily to inhibit growth.

As a rule these abnormal cell inclusions are not of frequent occurrence; it is rare to find more than one in a $\frac{1}{6}$-inch lens field. Their appearance and size are shown in figs. 1, 2, and 3.

These inclusion bodies were next tested for chromatin by staining by
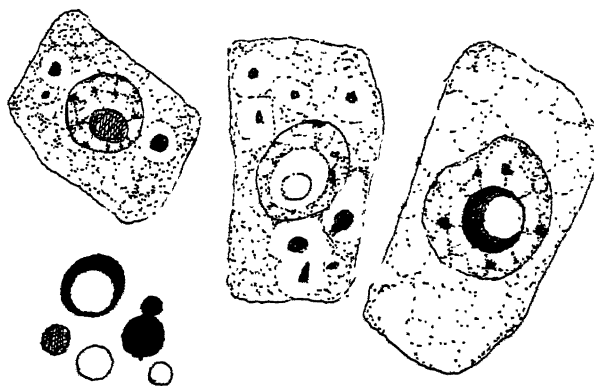
Fig. 3.—Fixed in Zenker and stained with Heidenheim's iron hæmatoxylin; three cells showing variation in nucleolar staining. Numerous inclusion bodies are drawn separately to show variation in staining.

Feulgen's method, and, as shown in figs. 4 and 5, it was found that they take the stain like chromatin.

Sections were also stained by Auerbach's method, which stains nucleoli red and chromatin blue-green: the inclusions stained olive-green and not red, confirming therefore the results obtained by Feulgen's method and showing that they contain chromatin. In order to see whether these bodies contained fats or lipoids or were related to mitochondria or the Golgi apparatus, a number of fixing and staining methods were employed, and the results obtained are summarized in the following table :—

Fixative.	Stain.	NORMAL.				RADIATED.			
		Chromatin Granules in Nucleus.	Nucleolus.	Mitochondria.	Abnormal Cell Inclusions.	Chromatin Granules in Nucleus.	Nucleolus.	Mitochondria.	Abnormal Cell Inclusions.
ZENKER ...	Gram	Dark Violet	Violet	—	—	Dark Violet	Dark Violet to Unstained	—	Dark Violet to Unstained
ZENKER ...	Iron Haematoxylin	Black	Black	—	—	Black	Black to Grey or Unstained	—	Black to Grey or Unstained
ZENKER ...	Feulgen	Red-Purple	Unstained	—	—	Red-Purple	Usually Unstained; occasionally Red-Purple	—	Red - Purple; sometimes Unstained
ZENKER ...	Auerbach	Blue-Green	Red	—	—	Blue-Green [Reddish, 5–7 days after radiation]	Red; occasionally Unstained	—	Olive Green or Unstained
CARNOY ...	Iron Haematoxylin	Black	Black	—	—	Black	Black to Grey or Unstained	—	Black to Grey r Unstained
CARNOY ...	Auerbach	Blue-Green	Red	—	—	Blue-Green	Red or Unstained	—	Blue-Green or Unstained
SOHRIDDE ...	Unstained	Unstained	Unstained	Unstained	—	Unstained	Unstained	Unstained	Unstained
SOHRIDDE ...	Iron Haematoxylin	Black to Grey	Black	Black to Grey	—	Black to Grey	Black to Grey or Unstained	Black to Grey, Swollen	Black to Grey or Unstained
MANN-KOPSCH	Differentiated Turpentine or H₂O₂	Yellow	Yellow	Black to Grey	—	Yellow	Yellow	Black to Grey, Swollen	Yellow; rarely Black

Their appearance after fixation with Carnoy shows that they are not of a lipoid or fatty nature. This is confirmed by their not being blackened by Schridde's fixation. Stained with iron hæmatoxylin after Schridde they behave like mitochondria, varying from black to grey; but their occurrence after fixation with Zenker or Carnoy negatives their being related to mito·
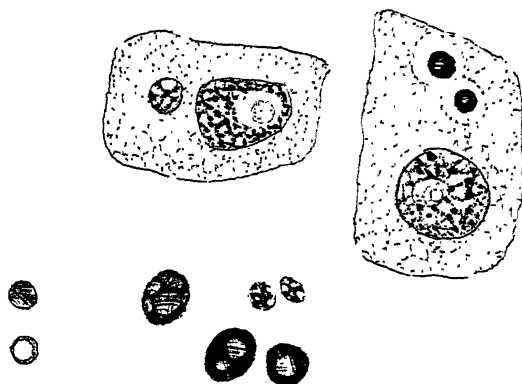

FIG. 4.—Fixed in Zenker and stained by Feulgen's method : two cells, one containing two nuclei, one very small; the other containing two deeply stained inclusion bodies ; five other inclusion bodies specially drawn showing variation in staining, and two very small nuclei from a multi-nucleated cell for comparison.

chondria ; and, further, by the Mann-Kopsch method they are differentiated from mitochondria, which stain black unless decolourized, whereas the inclusion bodies are yellow.

One is forced, therefore, to the conclusion that they consist of chromatin because they follow closely the staining qualities of the chromatin granules
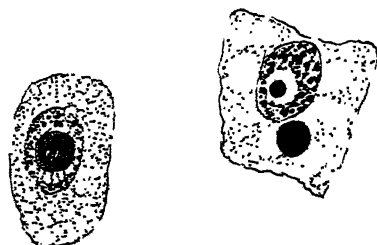
FIG. 5.—Fixed in Zenker and stained by Feulgen's method ; this shows that after radiation the nucleoli sometimes take the stain. One of the cells contains a large deeply stained inclusion body.

of the nucleus of the non-dividing cell as seen in the table, and especially because they pass the test for chromatin devised by Feulgen and stain olive-green by Auerbach's stain.

They do not appear to enter into the mitotic figure when cells containing them divide, since they have been observed in dividing cells lying outside the spindle in all stages of mitosis.

As regards the abnormal staining qualities of the nucleolus after radiation,

it shows that the nucleolus consists of, or contains, two substances ; one which is chromatic and sometimes indeed stains like chromatin, and a non-chromatic portion which is manifested after radiation for the reason that radiation tends to destroy the power of the nucleolus to take up the stains. Sometimes one sees after radiation a nucleus containing two nucleoli, one stained and the other unstained.

There is other evidence that the nucleolus has this double composition, which these results therefore confirm.

Discussion.—The evidence and especially the fact that these inclusion bodies stain by Feulgen's method suggest that they are small particles of chromatin ; and since it is known that chromosomes are sometimes eliminated during mitoses following radiation, it can well be that their presence in the cytoplasm is a microscopical demonstration of this. There is, however, an alternative explanation : very similar cytoplasmic inclusions have often been observed in cells and the conclusion drawn that they are nucleolar extrusions. Walker and Debaisieux (1909) observed them in many plants and animals, in Phaseolus (bean), in Hydra, Spongilla, in the small and large intestine of the rabbit, in Planarians and in human skin. They also found them in cancer of the breast and uterus and in mouse cancer ; a number of observers—Szily (1911), Weber and Bequet (1909), Murray (1916), Ludford (1925)—have noted their occurrence in both sarcoma and carcinoma. They observed that their staining qualities changed from being oxyphilous within the nucleus to basiphilous in the cytoplasm. Both Benoit (1921) and Ludford (1925) describe the occurrence of nucleolar extrusions in the epithelial cells of the epididymus. Ludford gives a figure of an extrusion passing through the nuclear membrane. He says that the change from oxyphilous to basiphilous staining often takes place within the nucleus before extrusion. Lewis (1923) observed them in *in-vitro* cultures of fibroblasts and notes that they become surrounded by a vacuole ; he observed extrusion taking place in the living cell. Ludford also found them in tar-produced epithelioma as well as in fibroblasts from these tumours. Several observers, among them Hogben (1921), have described nucleolar extrusions in oocytes and concluded that they have to do with the formation of yolk. They have been found in the silk gland of insects. On reading these papers and examining the figures of these authors, there is no doubt that these nucleolar extrusions are identical with the inclusions described in this paper and also with those described by Alberti and Politzer (1923), by Kumuro (1924), and by Levine (1929), who conclude that they represent eliminated chromosomes, as already mentioned.

We have therefore two explanations to choose from. Since these bodies stain with Feulgen's method and are basiphilous, it might be concluded that they are related to chromosomes rather than to the oxyphilous nucleolus which does not stain with Feulgen's method. On the other hand, they do not always stain in this way, and, moreover, the nucleolus itself has been observed sometimes to become basiphilous and to stain with Feulgen's

method (see fig. 5), confirming Ludford's observations. It follows that the staining qualities of these inclusions do not exclude them from being nucleolar in origin.

There are a number of facts against their being chromosomal in origin. Ludford's figures showing a nucleolus half in and half out of the nucleus, protruding through the nuclear membrane, and Lewis' description of extrusion occurring in a living cell in in-vitro culture are strongly in favour of the nucleolar origin. Furthermore, it is unreasonable to suppose that oocytes regularly eliminate chromosomes.

There is, however, the fact that chromosomes are sometimes eliminated in cells which have been radiated, and the question arises, What becomes of them ? There does not seem to be any reason why they should not form tiny vesicular nuclei, and perhaps the tiny nuclei shown in fig. 4 have such an origin : their size is quite in keeping with this supposition, since they are often quite as small or even smaller than the inclusions.

The fact that the inclusion bodies are structureless, apart from sometimes containing a vacuole, is also against their chromosomal origin.

I come tentatively, therefore, to the conclusion that they are nucleolar in origin. If this be so, then a number of interesting deductions may be drawn. In the first place, though normally the nucleolus is oxyphilous and does not stain by Feulgen's method, after radiation it may become basiphilous and stain with Feulgen. If Feulgen's method is a test for chromatin, then it must be concluded that the nucleolus can become charged with chromatin. This is in keeping with the view that the nucleolus is a factory for chromatin, which it passes on to the chromatin network and spireme of the nucleus.

Now, I have concluded in a previous communication (Mottram, 1932) that radiation holds up the passage of chromatic material from the nucleolus to the spireme by inhibiting the necessary conjunction between nucleolus and chromatin network ; and thus have accounted for the inhibition of mitosis which occurs when cells are radiated.

If therefore the nucleolus cannot pass on the chromatin which it forms, a reason why the nucleolus after radiation stains like chromatin is evident ; and also this may account for nucleolar extrusions. Nucleolar material collects in the nucleolus until no more can be held, then it is extruded through the nuclear membrane into the cytoplasm, where it is found staining like chromatin. In keeping with this is the observation made by Ludford (1921) that radiated cells tend to become hypochromatic with an increase of nucleolar material. This alteration has been observed in bean roots both in the present research and in the one previously referred to (Mottram, 1932).

All these findings therefore appear to fall under a generalization, that, whilst the nucleolus continues to produce chromatin after radiation it cannot pass it on to the nucleus.

These cell inclusions closely resemble some of the inclusions which have been observed in cancer cells and which were considered at one time to be parasites. The fact that a number of observers have found nucleolar extru-

sions in cancer cells strongly suggests that the cancer bodies and nucleolar extrusions are different names for the same structure. However, not all cancer bodies have a structure like nucleolar extrusions.

Conclusions.—Cytoplasmic inclusions staining like chromatin were observed in cells following radiation. It is concluded that these are nucleolar extrusions. There is an alternative explanation which cannot be entirely excluded : that they are eliminated chromosomes.

The first explanation falls into line with previous observations which appeared to account for the inhibition of mitosis following radiation by an interference with the passage of chromatin from the nucleolus to the chromosomes. The view that the nucleolus is a factory for chromatin is supported, and since radiation does not interfere with this process and since after radiation chromatin is not passed on to the chromosomes, it accumulates in the nucleolus, causing it to stain like chromatin, or it is also extruded into the cytoplasm, forming inclusions there.

Nucleolar extrusions occurring in cells after radiation and in cancer cells, closely resemble some of the cell inclusions which at one time were thought to be cancer parasites.

The radium used was on loan from the Medical Research Council and the expenses of the research were partly defrayed by a grant from the British Empire Cancer Campaign.

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OBITUARY.

JOHN ARTHUR THOMSON, Kt., M.A., LL.D., F.R.M.S.

By Edward Heron-Allen, F.R.S., F.R.M.S.

By the death of Arthur Thomson, as he was familiarly known, which took place at his home at Limpsfield in Surrey on February 12th, 1933, at the age of seventy-one, the world has lost one who, during the forty and odd years of his professorial life, was one of the most inspired and inspiring teachers of his era. As Walter Grierson (writing under his pseudonym of " The Enquiring Layman " in *John o' London's Weekly*) said (February 25th, 1933), without having the first-hand knowledge of men who have devoted their lives to original research in specialized fields, his range of knowledge, and exact knowledge, was amazing, and he was probably the most all-round man of science living.

He was born at Saltoun, East Lothian, on July 8th, 1861, son and grandson of incumbents of the Manse, and was their indicated successor in the Ministry—*Dis aliter visum.* Primarily educated at local schools, he graduated M.A. at Edinburgh University and completed the Divinity Course at New College, but, inheriting a compelling urge towards natural science from two generations of naturalists on his mother's side, he had studied zoology and botany at Edinburgh. The year 1883 found him at Jena studying under Ernst Haeckel, and two years later with Schulze at the Zoological Institute in Berlin. From Berlin he returned to Edinburgh, where, as Lecturer in Zoology and Botany, he speedily became recognized as the most popular science teacher of his time. So widely spread was his reputation in this capacity that, in 1899, he was appointed Regius Professor of Natural History in the University of Aberdeen, in succession to Alleyne Nicholson, a post which he filled with world-renowned success until his retirement in 1930, upon which occasion he received the honour of knighthood. What " contributions to natural knowledge " Arthur Thomson, with his untiring industry and open mind on all scientific subjects, might have made, had his time not been fully occupied (one might say almost over-occupied) by the duties of his University chair, his amazing popularity as a lecturer, and his unremitting literary industry, it were hazardous to conjecture. All that we have of his scientific work is mainly systematic, and deals, to all intents and purposes, exclusively with the Alcyonaria, upon which he was an acknowledged authority. Even this work of his is widely

scattered, consisting of memoirs published in the reports of expeditions, such as the Australian *Thetis* Expedition, the Dutch *Siboga* Expedition, and the collection at the *Institut Océanographique* at Monaco, whilst his own collection of type and other specimens, presented by him to the Natural History Museum on his retirement from Aberdeen, remains to all time as a monument to his precise method and phenomenal industry.

Apart from his work at the University, his reputation as a lecturer was worldwide. In 1915 he delivered the Gifford Lectures at St. Andrews; he was Terry Lecturer at Yale University and Morse Lecturer at the Union Seminary, New York, in 1924; he lectured at McGill University, and in South Africa; and his course of Christmas Lectures at the Royal Institution in 1920 on " The Haunts of Life " (published in book form in 1922) are within the memory of, and a delightful memory to all of us. He had already, in 1898, delivered two lectures at the Royal Institution on " The Biology of Spring," and in 1900 (March 30th) delivered the Friday Evening Discourse, entitled " Facts of Inheritance." * Besides these more important occasions, he was always ready and willing to lecture before scientific societies great and small. As he told me, when staying at my house in London on the occasion of the lecture he delivered at my request before the Royal Microscopical Society, he regarded this as a duty which every man who has the spread of scientific knowledge at heart should always be ready gladly to undertake.

As a writer his output was amazing, so much so that his more serious works, such as " The Evolution of Sex," published in collaboration with the late Sir Patrick Geddes in 1889, " The Science of Life " (1899), and his last great work, " Life : Outlines of General Biology " (1931), are apt to be thrown in the shade for the general reader by his more popular works, such as " The Wonder of Life " (1914), " The Outline of Science " (which he edited and mostly wrote), " The Secrets of Animal Life " (1919), " The Haunts of Life " (1922), and " The New Natural History." Of " The Evolution of Sex " Sir Peter Chalmers Mitchell, writing in *The Times* (February 13th, 1933), said : " Thomson brought to it his wide knowledge of the most recent literature and a gentle philosophy which saw good in all things, while Geddes brought a schematizing mind, which could compose facts apparently discrete into an ordered whole." A page of this Journal might be filled with the list of his published works, textbooks, volumes of essays, and innumerable popular articles on natural history. A pathetic interest attaches to his last philosophical work, two articles entitled " Men and Women of the Future," both published in *John o' London* after his death.

Honorary doctorates were conferred upon him by the McGill University, the University of California, and by his own Universities of Edinburgh and

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* In November 1931, he delivered the Riddell Memorial Lectures at Armstrong College, Newcastle-on-Tyne.

Aberdeen. It is impossible to give more than a fragmentary account of his many interests, and it is no tsurprising that, apart from his work on Alcyonarians, he was not able to devote time to those " contributions to natural knowledge " which might have led to his candidature for, and election to, the Fellowship of the Royal Society. Writing to me in 1921, he complained half humorously of " too many students, and duplicated classes," relieved, however, by a lifelong devotion to his national recreation, golf. He was a popular *habitué* of the Spey Bay Links.

It is a pleasure to write of his long connection with the Royal Microscopical Society. He was Assistant Editor of our Journal for over forty years—from 1885 to 1926—and became President in 1910. On taking the Chair in February, 1910, he read a paper on " *Dendrobrachia fallax*, a Rare and Divergent Antipatharian," and in March read a paper by his pupil, Miss S. L. M. Summers, on " Antipatharians from the Indian Ocean." The distance between Aberdeen and London militated against his attendance at all our Meetings, and in April and May the Chair was taken by Dr. E. J. Spitta and Mr. A. N. Disney, Vice-Presidents ; as he wrote to me : " The distance is formidable, and, as you know, Scottish professors are rarely pecunious." In June he exhibited a rare Synaptid from Geelong, Victoria, and read a paper on the Alcyonarians of the Shackleton Expedition. In October Dr. Spitta took the Chair for him, and in November he read a paper on " Japanese Pennatulids." In December, Dr. Spitta being in the Chair, Dr. H. J. Plimmer was elected to follow him in the Presidency. In January, 1911, his Presidential Address on " The Determination of Sex " was, in a sense, epoch-making, for it was a résumé of his studies and later notes on the subject which he had opened with Geddes in " The Evolution of Sex " in 1889, and was the foundation of his later work, also in collaboration with Geddes, on " Sex " in 1914. This important and extraordinarily lucid exposition of his subject was printed in our 1911 Journal (pp. 141–59). It was on this occasion that he pleaded with the Society for a proper exhibition and catalogue of its collection of microscopes, and at the same time pleaded that the Society's collection of slides should be developed, to make " a reference Museum of Microscopical Preparations, which would be a valuable asset, not only to the Society, but to scientific workers in general."

Arthur Thomson did not, as Presidents are nefariously apt to do, cease to take an active interest in the affairs of the Society when his term of office was concluded. When I had the honour of occupying that position he came up (March 15th, 1916) from Aberdeen to deliver an address on " Originative Factors in Evolution," an address which foreshadowed his notable works, " Evolution " and " The Gospel of Evolution," published in 1925, in which his earlier work in collaboration with Geddes in 1911 was amplified and carried many steps further. Sir Ray Lankester, who was present on that occasion, described the address as " one of the best he had ever heard on that difficult and profound subject of variation and heredity, presented in a delightful and charming way " (J.R.M.S., 1916, p. 250). Prof. Dendy voiced

the same opinion. It was on this occasion that Ray Lankester fulfilled the promise—or, rather, threat—that he would " attack me in my own Chair " upon " The Supposed Exhibition of Purpose and Intelligence by the Foraminifera." He had sent me his paper beforehand, and I had sent him the reply I was going to make, so that he could prepare his apparently impromptu rejoinder. We enjoyed ourselves very much ! In the discussion which followed Profs. Dendy, Flinders Petrie, Benjamin Moore and Arthur Thomson took part, the latter, in a carefully prepared speech on " purposefulness or purposiveness," describing the phenomena I had brought forward as an inclined plane, the conceptual, the perpetual, the instinctive, and the organized, culminating in purposiveness as a whole. He supported me, to my warm satisfaction, quoting Prof. Bateson's Presidential Address before the British Association in Australia in 1914, in which he had said that " primordial forms of life are not necessarily very simple. They are richly endowed with initiative and potentialities." *

Not only Thomson's personal friends, among whom I was privileged to count myself, but all who heard him lecture, could not fail to appreciate his sly humour, the " danger signal " for which was always a casting up of his eyes towards a distant corner of the ceiling, and the charm with which he would emphasize an important point with some humorous—but never frivolous—aphorism. He stayed with me in London on several occasions, and the evenings we spent together live in my memory as some of the most delightful and inspiring hours of my life.

To sum up the work of Arthur Thomson, one may say without fear of contradiction that when " natural knowledge " has proceeded beyond the point which it attained in his most serious works, he will be remembered as one who perhaps did more to popularize science and bring its important truths within the ken of the intellectual " man in the street " than any of his contemporaries, and, I dare to say, than any of his predecessors.

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* Founded upon this discussion on my "Phil. Trans. Paper " (B. Vol. 206, 1915), and my Friday Evening Discourse, *On Beauty, Design, and Purpose in the Foraminifera* (Roy. Inst., May 21st, 1915), he wrote a popular article on the subject in the *New Statesman* (October 23rd, 1915), which he entitled "Before the Dawn of Art," and I must confess that he carried my observations to far greater teleological lengths and conclusions than I should ever have dared to carry them myself.

The Riddell Lectures, the last important series that he delivered, give us an illuminating example of what may be said to have been his most significant and lovable characteristic—a deeply religious and reverential attitude towards the factors of evolution, combined with a scholarly and delicate sense of humour, and in them he summed up his attitude towards this phenomenon of purposiveness in the pregnant aphorism of Aristotle : " If Reason in the end—the stage that we at present know—then Reason in the beginning."

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE, STAINING, ETC.

The Staining of Non-acid Fast Tubercle Bacilli and Granules.—E. G ALEXANDER (" Improved Staining Techniques for the Demonstration of Non-acid-fast Tubercle Bacilli and Granules," *Science,* 1932, **75**, 197–8). Two methods are described, the material being obtained from a 10 days' old strain of avian tubercle bacillus grown on glycerine agar containing either 10 p.c. normal horse serum or 10 p.c. immune rabbit serum. The smears were stained for 5 minutes by the Ziehl-Neelsen method, decolorized with 3 p.c. acid alcohol, and rinsed under the tap. Method 1 : Counterstain with Löffler's methylene blue ; add immediately 6–8 drops of 0·05 p.c. NAOH, agitate gently and allow to stand for 2–3 minutes. Wash under the tap, dry, and examine. The contrast between red and blue is striking. Method 2 : Flood the smear with 8 drops of a 1 p.c. aqueous crystal violet. Add immediately 6–8 drops of 5 p.c. $NaHCO_3$, agitate gently and allow to stand for from 2 to 3 minutes. Wash under the tap, apply Gram's iodine for 2 minutes, wash and decolorize 20–30 seconds with a mixture of equal parts of acetone and 95 p.c. alcohol; wash and dry. The non-acid-fast bacilli appear violet. In addition the granules in the red acid-fast and the violet non-acid-fast bacilli stand out as violet-black bodies. For best results by Method 1 with bovine and human strains 1–5 p.c. NaOH and 3–10 p.c. NOH should be used respectively. For Method 2 saturated $NaHCO_3$ should be used both for bovine and human strains.   G. M. F.

A Modified Wright's Stain.—F. D. LAROCHELLE (" Modification of Use of Wright's Stain," *J. Lab. and Clin. Med.,* 1932, **27**, 818–19). Place the air-dried smear over a watch glass, the margin of which is absolutely horizontal ; cover with 30 drops of Wright's stain for 2 or 3 minutes. Dilute with tap water just on the alkaline side of neutrality and after 2–3 minutes add 5 or 6 drops of Giemsa's stock solution for 6–8 minutes. Wash with tap water just on the acid side of neutrality. Dry in air and examine with liquid petrolatum.   G. M. F.

Paraffin Embedding after Terpineol or Methylbenzoate in Place of Absolute Alcohol and Benzol (Xylol, Chloroform) for Tough Objects.— A. WETZEL (" Paraffineinbettung über Terpineol oder Methylbenzoat unter Vermeidung von absolutem Alkohol und Benzol (Xylol, Chloroform) für schwerschneidbare Objekte," *Ztschr. Wiss. Mikr.,* 1931, **48**, 360–3). The method is of value when chitin, yolk, or any horny substances have to be sectioned. Methylbenzoate or preferably terpineol is employed between 96 p.c. alcohol and paraffin, absolute

alcohol being entirely dispensed with. The terpineol is prepared by dissolving 50 gm. in 10 gm. of paraffin of 56°–58° C. melting-point at 45° C. The terpineol should be anhydrous, while the methylbenzoate must be colourless, evaporate slowly, and leave no residue. Tissues removed from 96 p.c. alcohol are placed in mixtures of terpineol or methylbenzoate with 96 p.c. alcohol as follows : 1 : 1 for 1 hour or till the material sinks ; 2 : 1 and 3 : 1 for an hour each, then through three changes of terpineol (or methylbenzoate) alone or with some calcium chloride or carbide to remove any traces of water or alcohol. High containers are of advantage, as the objects sink to the bottom, while the alcohol, if present, can be pipetted from the surface. Tissues are next passed through three 1-hour changes of paraffin and terpineol. High containers should be used and the material suspended in the upper portion of the glass, as there the paraffin is purer owing to its lower specific gravity. Material is finally embedded in pure paraffin, melting-point 52°–56° C.   G. M. F.

A Method of Staining the Anterior Lobe of the Pituitary.—R. CLEVE-LAND and J. M. WOLFE (" A Differential Stain for the Anterior Lobe of the Hypo-physis," *Anat. Rec.*, 1932, **51**, 409–13). The following method serves to demon-strate four types of cell in the anterior lobe of the pituitary with considerable ease. Fix in Regaud's solution for 5 days, changing every 24 hours. Transfer to 3 p.c. potassium bichromate for 8 days, changing it every 48 hours ; place in running water for 24 hours and dehydrate very slowly. Clear in cedar oil, xylol and embed in 60° paraffin. Stain two to three thick sections in Ehrlich's hæmatoxylin for 3 minutes, rinse in distilled water. Blue in a dilute solution of lithium carbonate and transfer to a 5 p.c. solution of potassium bichromate for 3 days, changing daily and keeping in the dark. Rinse in distilled water ; stain for 20–30 seconds in 5 p.c. erythrosin ; pass through two changes of distilled water. Stain in a 2 p.c. solution of orange G in 1 p.c. solution phosphomolybdic acid for 2–3 minutes. Rinse, immerse in 1 p.c. aniline blue for 30–60 seconds. Rinse, pass through 95 p.c. alcohol, absolute alcohol, xylol and mount. Only Grübler's stains were used in this technique.   G. M. F.

A Method for Staining the Neural Crest.—L. S. STONE (" Selective Staining of the Neural Crest and Its Preservation for Microscopical Study," *Anat. Rec.*, 1932, **51**, 267–73). Since the mesectoderm is stained, the mesentoderm unaffected by Nile blue sulphate as a vital stain, the two layers can thus be differentiated. Prepare agar sheets by pouring 1–2 p.c. agar on a glycerinated surface. After setting, strip the agar off and allow to dry on clean paper. Place in 1 p.c. Nile blue sulphate for 1 week. Rinse the strips in distilled water and deposit on a glass surface covered with a film of beeswax. Press flat with finger so that they will adhere. Before applying the agar to the embryo soak it in distilled or tap water for 2–24 hours. Place the strips of agar on the crest of the neural fold in the cranial region of embryos of Amblyostoma, Pleurodeles, or Rana in $\frac{1}{4}$–$\frac{3}{4}$ normal Ringer's solution for 45–60 minutes. Fix the tissue in Zenker's acetic fluid for 2 hours and wash under the tap for 1 hour. Transfer to 1 p.c. phosphomolybdic acid for 1 hour and pass through 50, 70, 80, 95, and 100 p.c. alcohols, each with 0·1 p.c. phosphomolybdic acid, at 30 minutes' intervals. Place in a mixture of absolute alcohol with the same amount of phosphomolybdic acid, and cedar oil. Leave in cedar oil over night. Pass through three 20-minute paraffin baths and embed. The blue stain remains unaltered. Sections may be freed from paraffin and mounted directly or counterstained. In the latter case, the alcohols must contain the same percentage of phosphomolybdic acid as those used before embedding.   G. M. F.

A New Embedding Material.— S. T. ORTON and J. POST ("Some Experiments with a New Embedding Material," *Bull. Neurol. Inst., New York.* 1932, **2**, 302). The new material is a water-soluble wax, a glycol stearate melting at 48·5° C. Small blocks of brain tissue fixed in Zenker or Bouin are well washed in water and then placed directly in the melted wax in a paraffin oven for 48 hours, being changed six times. They are allowed to solidify at room temperature and sections 2–4μ in thickness are cut and mounted on the slide with Mayer's glycerine albumen-fixative. The wax is dissolved out with chloroform for 1 minute, then the sections are passed to absolute alcohol down to water. Sections can be stained with hæmatoxylin and eosin, etc., or Nile blue sulphate as a fat stain.

G. M. F.

The Technique of Micro-incineration.—E. S. HORNING ("A Note on the Technique of Micro-incineration : Its Advantages as an Application for a Histo-chemical Study of Normal and Malignant Tissues," *J. Can. Res. Committee, Univ. Sydney,* 1932, **4**, 118–21, 2 pl.). A brief account of the technique of micro-incineration. Small pieces of tissue are fixed in a solution of nine volumes of absolute alcohol to one volume of neutral formalin, as it is found that this solution neither adds to nor detracts from the inorganic elements of the cell but gives good fixation and does not interfere with the ash deposits. After fixation for 24 hours the material is passed through several changes of absolute alcohol, cleared in xylol, and embedded in paraffin, sections being cut at less than 5μ. Care must be taken to avoid any contact with water, the sections being smoothed out on a glass slide with the aid of a drop of absolute alcohol. The preparations are then placed on a small quartz slab and transferred to a special electric quartz oven and incinerated at a temperature of from 625° to 650° C. for 25–45 minutes. As certain tissues, such as cancerous tissues, remain carbonized longer than others, it is necessary to incinerate them for longer periods and therefore to insert a thin platinum sheet between the glass slide and the quartz slab. The incinerated sections are mounted in a dry manner by placing a thin cover-glass over them, the sides being sealed with paraffin. The preparations are viewed by dark field illumination, using preferably a Zeiss cardioid condenser. Iron, when present, assumes the form of iron oxide and has a bluish colour ; calcium, also present as an oxide, is more difficult to determine. Silicates are detectable by their birefringence when viewed by polarized light.

G. M. F.

The History of Staining.—R. S. CUNNINGHAM and H. J. CONN ("History of Staining. Methods for the Preservation of Supravitally Stained Material," *Stain Technol.,* 1932, **7**, 115–9). A review of the various methods of handling supravitally stained tissues for the purpose of making permanent preparations. G. M. F.

Eosin B.—W. C. HOLMES, C. G. MELIN, and A. R. PETERSON (*Stain Technol.,* 1932, **7**, 121–7). Commercial samples of eosin B are not 4-, 5-dibromo- 2-, 7-dinitro-fluorescein, as is usually stated in dye indices, but mixtures containing other bromonitro derivatives of fluorescein as well as dibromodinitro derivatives. The colour acid method provides a substantially reliable means of determining actual dye content with commercial samples of the dye, but the reduction method may prove misleading. G. M. F.

A Rapid Paraffin Embedding Method.—W. J. BAUMGARTNER and B. M. WELCH ("A New Time-saving Device for Embedding in Paraffin," *Stain Technol.,* 1932, **7**, 129–30). A simple substitute for the folded paper boxes or watch crystals used for embedding specimens in paraffin is described. Short sections of rubber

tubing are set on a glass slide or a piece of plain window glass an inch or more square. The glass is rubbed with glycerine before use and the tubing is cooled. As the paraffin cools it shrinks, but at the same time the rubber tubing yields on all sides so that the shrinkage is not all from the top and there is no " central dip." The thickness of the rubber tubing may vary, so long as the tubing maintains its shape. Tubing of 10 and 20 mm. in diameter, and sections cut 7 and 14 mm. in length are most suitable. If the rubber tubing is placed on a round rod of wood which is then put on a lathe the tubing can be readily cut into sections while the wood is turning.   G. M. F.

Hæmatoxylin and Mallory's Connective Tissue Stain.—S. WEISS (" Mallory's Connective Tissue Stain following Hematoxylin," *Stain Technol.*, 1932, **7**. 131–33). The following combination of hæmatoxylin with Mallory's connective tissue stain is of use in bringing out nuclei as well as in the differentiation of tissue. Sections are slightly overstained with Mayer's hæmatoxylin (50 gm. potassium alum and 0·2 gm. sodium iodate added to 1 litre of 0·1 p.c. aqueous hæmatoxylin) washed and stained for 30 seconds to 1 minute in 0·04 p.c. aqueous acid fuchsin, then stained for 4 minutes in 0·5 gm. aniline blue and 2 gm. orange G dissolved in 100 c.c. of 1 p.c. aqueous phosphomolybdic acid. Sections are then passed through 95 p.c. to absolute alcohol, cleared in xylol and mounted in Canada balsam.   G. M. F.

A New Celloidin Technique.—G. L. WALLS (" The Hot Celloidin Technic for Animal Tissues," *Stain Technol.*, 1932, **7**, 135–45, 1 text-fig.). Any incubator or embedding oven may be used provided it is not heated by an open flame or an exposed incandescent metal. It is set at 60° C. Embedding is carried on in bottles which should have thick lips and bottoms of uniform thickness. The concentrations of solutions used are 2, 4, 6, 10, and 14 p.c. Photographer's " soluble cotton " is suitable and cheaper than other nitro-cellulose ; Mallinckrodt's " pyroxylin " should be used in the thickening process. The solvent consists of equal parts of ether and either 96 p.c. or absolute alcohol. Chloroform is used for hardening, after which blocks are stored in a mixture of equal parts of 96 p.c. alcohol and glycerine. After dehydrating the tissue to at least 96 p.c. alcohol, transfer to the embedding bottle and add 2 p.c. celloidin to ¼ inch or so above the pieces ; leave for 24 hours ; then placed in the succeeding solutions each for 12 hours. When the 14 p.c. solution is added a little pyroxylin is also added to make the 14 p.c. solution very thick. Allow the mass to thicken for 24 hours ; sections should not be cut thinner than 5μ.   G. M. F.

The Staining of Paschen Bodies.—J. CRAIGIE (" A Method of Staining the Elementary (Paschen) Bodies of Vaccinia," *J. Path. and Bact.*, 1933, **36**, 185). The stain has the following composition : Mercurochrome 220 soluble (H. W. & D.) 2 p.c. aqueous solution, 1 c.c. ; $M/5$ $Na_2HPO_4.2H_2O$ (or $Na_2HPO_4.12H_2O$) 7 p.c. aqueous solution, 5 c.c. ; methylene azure A (azur I) (certification no NA_{24}) 1 p.c. aqueous solution, 1 c.c. ; distilled water, 75 c.c. ; methylene blue (U.S.P. med.), certification no. NA_5 1 p.c. aqueous solution, 25 c.c. The solutions are added in the order stated. The mixture, which must not be filtered, retains its staining qualities unimpaired when kept at room temperature for three months. The procedure is as follows : (1) Spread films very thinly in the same way as a blood film. With preparations from the skin, suspend scrapings from the lesion in distilled water first. Dry. (2) Wash in two changes of distilled water for 5 minutes. Dry. (3) Fix in methyl alcohol for from 5 to 10 minutes. Dry. (4) Rinse in distilled water and shake or blot off excess water. Cover film with 6 drops of

2 p.c. aqueous mercurochrome for from 5 to 10 minutes ; rinse rapidly in tap and then distilled water. Blot off excess water. (5) Cover film with stain described above (6 drops) for from 5 to 10 minutes. (6) Rinse off stain as rapidly as possible : blot and dry immediately or simply blot and dry without rinsing. As water will partly dissolve out the stain from the elementary bodies, the preparation must be rapidly dried. The stain may be used for demonstrating bacteria in tissue sections. Zenker fixed sections are first stained in 0·05 p.c. aqueous mercurochrome for 5 minutes then rinsed and placed in a 1 in 20 aqueous dilution of the stain for 15 minutes. After rinsing in water sections are blotted and differentiated for approximately 1 minute in 95 p.c. alcohol, the section being kept in constant motion. When the sections are red, dehydration is rapidly completed in absolute alcohol. Nuclei and organisms stain a deep blue.   G. M. F.

Methods of Staining Vaccinia Virus.—T. TANIGUCHI, M. HOSOKAWA, S. KUGA, Y. KOMORA, and F. NAKAMURA (" Studies on the Virus of Smallpox," *Jap. J. Exp. Med.*, 1932, **10**, 581–98, 2 pl.). Numerous methods are given for the demonstration of the virus of vaccinia of which the two most satisfactory are as follows : *Method I :* It is essential to use slides which have been thoroughly cleaned in chromic acid for 24 hours, washed in running water for the same period, and then soaked in 50 p.c. alcohol. Smears should be dried in the air for 24–48 hours in order to make the smeared material firmly adhere to the slide. The dried smear is soaked in pure acetone for a few seconds to 1 minute. The preparation is then washed and soaked for 1½–2 minutes in the following mordant : cadmium iodide is dissolved in neutral concentrated formalin to form a 1 p.c. solution, characterized by a yellowish-white turbidity ; to this is added concentrated hydrochloric acid until the turbidity disappears. The smear is then mordanted for 30 seconds in a 1·0 p.c. aqueous solution of eosin prepared by dissolving 0·2 gm. of eosin in 10 c.c. of alcohol to which 5 c.c. of concentrated formalin is added, followed by distilled water till the amount reaches 200 c.c. It should be a clear orange-red fluid without any turbidity. The smear is then stained for a few seconds in carbol fuchsin, washed, and dried. *Method II :* The following solutions are prepared : (1) 0·5 gm. of NaOH and 0·5 gm. of Na_2CO_3 are dissolved in 10 c.c. of distilled water, absolute alcohol being added till the volume reaches 100 c.c. (2) 2·0 c.c. of pure sulphuric acid is added to 10 c.c. of water and then diluted with absolute alcohol to 100 c.c. (3) 5·0 gm. of zinc iodide or cadmium iodide and 0·5 gm. of iodine are dissolved in 100 c.c. of absolute alcohol. (4) 1 p.c. aqueous solution of eosin. (5) Ziehl's carbol fuchsin. (6) Acetone. The smear is kept in reagent (1) for 1 minute and washed, then in reagent (2) for 1 minute in order to remove anything soluble in acid or alkali; mordanted in reagent (3) for 1 minute and washed ; kept in reagent (4) for 30 seconds and washed ; stained in reagent (5) for a few seconds, washed and differentiated in reagent (6) for 1 minute and dried. The virus is stained with fuchsin.   G. M. F.

A Method of Staining Fæcal Protozoa.—R. J. PICKARD and C. RICE (*J. Lab. and Clin. Med.*, 1932, **27**, 493–4). Fix fresh smears of fæces in alcoholic Bouin's solution (30 c.c. 80 p.c. alcohol saturated with picric acid, 12 c.c. of 40 p.c. formalin, and 3 c.c. of glacial acetic acid) for 1 hour. Harden for 5 minutes in 95 p.c. alcohol, then to 75 p.c. alcohol for 5 minutes and two changes of water. Mordant in 3 p.c. iron alum for 15 minutes at 32° C. for the rapid technique, or 12 hours for the longer proceeding at room temperature. Wash in distilled water and stain in 1 p.c. hæmatoxylin for 15 minutes at 32° C. for the rapid technique, or 12 hours at room temperature for the other. Wash in water, differentiate in

iron alum at 32° C. or at room temperature. Wash in water, then in 95 p.c. alcohol. Clear and examine in creosote oil under oil immersion.   G. M. F.

Neutral Red for Weigert-Pal Sections.—I. J. KIRKMAN ("Neutral Red as a Counterstain for Pal-Weigert Sections," *Anat. Rec.*, 1932, **51**, 323–6). Counterstain Pal-Weigert sections in neutral red (neutral red, Coleman and Bell, 1 gm.; distilled water, 500 c.c.; 1 p.c. acetic acid, 2 c.c.) for 10–20 minutes or longer. Rinse in distilled water, differentiate in 95 p.c. or absolute alcohol, dehydrate, clear and mount. A longer period of overstaining permits of almost complete differentiation of the background, leaving the glial cells faintly pink, whereas the nerve cells take up the stain brilliantly. Nucleoli, nuclear membranes, and Nissl granules stand out clearly against a pale pink cytoplasm. The solution can also be used as a Nissl stain on Bouin or formalin fixed material and gives as good results as sections stained by the Huber toluidine-blue method.   G. M. F.

The Bleaching of Melanin in Sections.—A. STRAUSS ("Über die Bleichung des Melanins," *Ztschr. Wiss. Mikr.*, 1932, **49**, 123–5). This method for bleaching histological preparations depends on the fact that melanin dissolves under the action of potassium hydroxide and hydrogen peroxide, or potassium hydroxide and manganese dioxide. Paraffin sections of strongly pigmented melano-sarcomata served as material. Experiments showed that a pH well on the alkaline side hastened the bleaching, while the concentration of H_2O_2 is of less importance. Thus bleaching is achieved with 30 p.c. H_2O_2 with 0·7 p.c. KOH within 45 minutes, but in 2 days without KOH; similarly 10 p.c. H_2O_2 with 0·7 p.c. KOH takes 45 minutes and without KOH in $2\frac{1}{2}$ days. Manganese dioxide slightly hastens the action when added to a neutral medium and has almost no effect with an alkaline. Lipofuchsin is also bleached, but hæmatogenous pigments are unaffected. If sections are to be stained after bleaching a 3 p.c. solution of H_2O_2 with 1 p.c. Na_2HPO_4 is used instead of KOH; neutralize with 1 p.c. acetic acid and rinse in water before proceeding further.   G. M. F.

The Accumulation of Trypan Blue in the Ganglion Cells of Various Parts of the Nervous System.—T. TSCHETSCHUYEVA ("Über die Speicherung von Trypanblau in Ganglien verschiedener Gebiete des Nervensystems," *Ztschr. Exp. Med.*, 1930, **69**, 208–19). The ganglion cells of rabbits take up trypan blue after intravenous or subcutaneous injection, the coloration being most intense in the sympathetic ganglia, weakest in the spinal and intermediate in the cerebral ganglia. Mesodermal cells first take up the stain, then satellite and ganglion cells, the latter more especially when showing regressive changes.   G. M. F.

Cytology.

Oligodendroglia in the Sensory Ganglia.—J. M. ORTIZ PICÓN ("La oligodendroglía de los ganglios sensitivos, Nota previa," *Rev. españ. de Biol.*, 1932, **1**, 19–24, 2 text-figs. (continuation of *Bol. Soc. españ. de Biología*)). In the sensory ganglia there are certain subcapsular cells the origin of which is at present uncertain. Evidence is brought forward to show that these subcapsular cells are homologous with the oligodendroglia.   G. M. F.

Observations on the Pericytes of the Central Nervous System.—L. URTUBEY ("Observaciones sobre los pericitos del sistema nervioso central," *Rev. españ. de Biol.*, 1932, **1**, 25–39, 10 text-figs.). The pericytes or cells of Rouget attached to the capillaries of the central nervous system are regarded as connective

tissue cells rather than muscle cells, though by the contraction of their prolongations they play an important rôle in regulating the calibre of the capillaries. No evidence was obtained that they can transform themselves into microglia cells.

<div align="right">G. M. F.</div>

Vital Staining Experiments in Scylla.—S. P. BANERJI (" Vital Staining Experiments in *Scylla serrata* (Forsk.)," *Bull. Acad. Sc. United Provinces, Agra and Oudh*, 1931, **1**, 76–9). Ovaries placed in neutral red diluted 1 in 25,000 revealed Golgi bodies and Vacuome as quite distinct structures.

<div align="right">G. M. F.</div>

Polyploidy and Metaphase Patterns.—E. B. WILSON (*J. Morph.*, 1932, **53**, 443–70, 1 pl.). A cyst of tetraploid first spermatocyte metaphases is described in the coreid hemipter *Archimerus alternatus* (Say), all other divisions in the testis being of normal diploid constitution. The striking fact is that in spite of the doubling of their number the chromosomes closely follow the group pattern characteristic of the corresponding normal divisions. In the latter the first metaphase always shows a ring of six autosome bivalents with a single m-chromosome bivalent at its centre and a single univalent X-chromosome lying outside the ring (as in coreids generally). In corresponding tetraploids the numbers are respectively 12, 2, and 2. Three additional interesting features of the tetraploids are : (1) The fact that the two m-bivalents are always lined up end to end to form an axial quadrivalent chain ; (2) that although two X-chromosomes are present (as in the normal female), they are never united to form a bivalent as in that sex ; and (3) that in the prophases (of which a few are present in the cyst), at least one pycnotic X, or chromosome nucleolus, is present. A critical discussion is offered of the general problem of the mechanism of chromosome movements and groupings, together with a review of recent literature. The conclusion is urged that the chromosomes themselves play an active and important part in these processes, and the possible genetic relations between chromosomes and spindle substance are discussed.

<div align="right">G. M. F.</div>

The Ultimate Structure of Living Matter.—D. JORDAN LLOYD (" Colloidal Structure and Its Biological Significance," *Biol. Reviews*, 1932, **7**, 254–73, 17 text-figs.). The ultimate structure of living matter depends on the constitution of the colloids of which it is made up. At one end of the scale there are highly active tissues such as primitive connective tissue, growing tissues, and generative cells with a high percentage of water which decreases with age ; the proteins are present as colloid sols, probably uni-molecular, each molecule consisting of a backbone which is not highly hydrated, carrying at periodic intervals side chains or limbs which are of varied character, often lengthy and of complex chemical structure, highly polar, heavily hydrated and undoubtedly playing an important rôle in the metabolic activities of the cells. In biologically inactive tissues such as mesentery tendons and skins, which are composed of connective tissue fibres which have largely a skeletal function, there is a low percentage of water, while the protein molecules are very little if at all hydrated and the side chains are shorter, less polar, and less hydrated. Finally, in the keratinous layer of the epidermis in animals, cellulose cell walls in plants, the biological function is purely mechanical, the importance of the backbone of colloid is paramount, the chemical potentialities of the limbs are of little significance and leave little space for the entry of water. Both keratin and cellulose give a definite X-ray picture showing that they are crystalline.

<div align="right">G. M. F.</div>

Intracellular Hydrion Studies.—R. CHAMBERS and G. CAMERON (" Intracellular Hydrion Concentration Studies. VII. The Secreting Cells of the Meso-

nephros in the Chick," *J. Cellular and Comp. Physiol.*, 1932, **2**, 99–103). The columnar cells of the walls of the proximal convoluted tubules in the chick possess a peculiar property of permeability which favours a unidirectional passage of the sulphonaphthalein indicators through their cytoplasm. During the intracellular passage of these indicators the colour assumed indicates a colorimetrically determined cytoplasmic pH of 6·8 $\pm$ 0·2. In obviously unhealthy tubules occasional cells assume colours indicating a pH of approximately 5·2 which, in other tissues, has been found to be due to an acid of injury. G. M. F.

The pH of the Fundulus Egg.—R. CHAMBERS ("Intracellular Hydrion-Concentration Studies," *J. Cellular and Comp. Physiol.*, 1932, **1**, 65–70). The cytoplasm of the Fundulus ovum was found to possess the same pH colorimetrically determined as that of a considerable variety of cells, viz. 6·8 $\pm$ and a value for the acid of injury of 5·4 $\pm$. G. M. F.

Ice in Protoplasm.—R. CHAMBERS and H. P. HALE ("The Formation of Ice in Protoplasm," *Proc. Roy. Soc.*, B, 1932, **110**, 336–52, 4 pls.). Experiments were carried out on the muscle fibres of frogs, fresh-water amœbæ, and the epidermal cells of the onion bulb scale. Cold alone does not kill the frog muscle fibres, even subcooling to − 15° C. Ice formed on the outside of the fibres at about − 1·2° C. and inside fibres at −1·6° C. On thawing the internal ice melted first, but a fibre could be subcooled to − 10° C. without internal freezing unless the sarcoplasm was brought into direct contact with ice by breaking through the sarcolemma, which therefore acts as a barrier. Ice formed inside the fibres was always in longitudinal lines. Amœbæ can be subcooled without death taking place to at least − 5° C.; internal freezing occurred only at − 0·6° C. and below. The barrier against internal freezing is the cell membrane. Most, if not all, of the internal water can be frozen. Internal freezing killed the animals; the cell contents, on thawing, formed a coarse mesh. G. M. F.

Interaction of Genes.—G. A. LEBEDEFF ("Interaction of Ruffed and Rounded Genes of *Drosophila virilis*," *Proc. Nat. Acad. Sc.*, **18**, 343–9). The fifth chromosome recessive ruffed (*ru*) gene in *Drosophila virilis* becomes dominant in the presence of the second chromosome dominant gene for rounded wings (*R*). The change is accompanied by the interaction of these two genes, which results in the appearance of a new roofed character in the F_1 and of five phenotypes in the F_2 in a 3 : 6 : 3 : 3 : 1 ratio. M. E. M.

Arthropoda.

Insecta.

Wing Production in Response to Light.—A. F. SHULL ("An Internal but Non-Genetic Character Affecting Wing Production in Response to Light in an Aphid," *Am. Nat.*, 1932, **66**, 180–3). A strain of the rose and potato aphid *Macrosiphum solanifolii* (*gei*) collected near Woods Hole, Massachusetts, in July, 1928, proved to differ from any other strain of this species in exhibiting a considerable range of yellow and green coloration. Some females were bright green; others distinctly yellowish. The response of these two types to light and darkness, with reference to wing production, was tested by rearing a group of each kind in continuous light, and an equal number in alternating light and darkness. The length of the light period was 8 hours, the dark period 16 hours. While only one of these experiments showed a marked difference in response in the offspring of the green and yellow parents, the difference in every case is in the

same direction. Since the parental colours are not of genetic origin, some physiological modification of a more or less permanent nature must have occurred in the individual. The nature of this modification is wholly unknown. It could be an infection, but there is no evidence of any other organism being present. The fact that there is a modification seems, however, to be established. M. E. M.

Plume-scales of the Pierinæ.—F. A. DIXEY ("The Plume-Scales of the *Pierinæ*," *Trans. Ento. Soc. London*, 1932, **80**, 57–64, 437 text-figs.). In a Presidential Address in January, 1910, before the Society, the author has already given a general account of the plume-scales which are found in the males of many genera of the *Pierinæ*, together with descriptions of the appearances presented by these structures in a large number of those forms which possess them. The general facts relating to the structure and distribution of these scales, and their significance as factors in determining questions of affinity, having been dealt with previously in the address, it has seemed needless to recapitulate the account. In the present paper the author gives outline figures of the plume-scales of all such Pierine forms as are readily accessible in the Hope Collection at Oxford, together with notes on the specific types of the scales in the separate genera. M. E. M.

African Carabidæ.—A. W. J. POMEROY ("African Beetles of the Family Carabidæ," *Trans. Ento. Soc. London*, 1932, **80**, 77–102, 3 pls., 43 text-figs.). The following preliminary scheme of work has been undertaken by the author in the present paper : (1) The importance of the female external genital armature in the family Carabidæ. (2) The value of the female genital armature as a systematic character in the subdivision of the tribe *Chlæniini* into sub-genera, and in defining species. (3) The microsculpture and puncturation of the elytra as a specific character in distinguishing closely allied species, when observed under a large magnification. (4) The laboratory technique employed. In the course of this paper a method is described for the photography of an entire beetle or other insects and objects. The results of this method, as shown in pl. I, are particularly good. M. E. M.

Extrusible Glandular Structure.—H. ELTRINGHAM ("On an Extrusible Glandular Structure in the Abdomen of *Mantispa styriaca*, Poda (Neuroptera)," *Trans. Ento. Soc. London*, 1932, **80**, 103–05, 1 pl., 1 text-fig.). Following the observation by Mr. Hugh Main that the male of *Mantispa styriaca* possesses an extrusible organ on the dorsal surface of the abdomen, the author has been able to study the habits of these insects in living specimens received from Mr. Main. The organ was found to be situated in the fourth and fifth segments. It occurs in the males only, is considered to have some sexual functions, such as the excretion of an aphrodisiac odour—which could not, however, be detected by the human olfactory sense. The gland is much in evidence when the insect is feeding, the extrusion swelling up and contracting with a certain degree of regularity, suggesting a rhythmic variation of the internal fluid pressure, probably due to peristaltic movements of the viscera. In an experimental association of a male and female which were placed in each other's presence in a glass box, no valuable function seemed to be performed by this organ in the attraction of the female, although it was occasionally extruded. Mating did not occur. The author gives a description of the morphology of the insect and this organ, as well as a description of the microscopical anatomy of the gland. M. E. M.

Neotropical Parasitic Hymenoptera.—J. G. MEYERS ("Biological Observations on Some Neotropical Parasitic Hymenoptera," *Trans. Ento. Soc. London*,

1932, **80**, 121–36, 5 text-figs.). These biological notes have been accumulated during exploratory work entailing much study and are, therefore, said by the author to be by no means complete life-history studies. The extent of parasitism under different conditions and the economic bearing of the parasites in question have been dealt with, for the more important species, in another paper (1931, *Empire Marketing Board*, 42) and their classification in a third (1931, *Bull. Ent. Res*, **22**, 267–77), where also several new species have been described. The observations here dealt with include : Parasites of Sugar Cane Borers *Diatræa* spp., *Ipobracon grenadensis* Ashm. ; Parasites of the Cacao Beetle, *Stirastoma depressum ;* Parasites of the Chayote Caterpillar, *Diaphania hyalinata ;* Parasites of the Papaya and Cassava sphinx Caterpillars ; and Miscellaneous Records. M. E. M.

Abyssinian Microlepidoptera.—E. MEYRICK ("Entomological Expedition of Abyssinia," *Trans. Ento. Soc. London*, 1932, **80**, 107–20). These are probably the first records of Microlepidoptera from Abyssinia. Fifty species are included in the present collection, and as most were collected at an altitude above 8000 feet, it is not surprising that forty-two specimens are new to science. Three of these represent new genera. With some exceptions which the author discusses, the Abyssinian insects do not appear to be alien in type to the general African fauna. Descriptions are given of all the new species. M. E. M.

Parasite of the Grain Moth.—N. S. NOBLE ("Studies of the *Habricytus cerealellæ* Ashm., a Pteromalid Parasite of the Angoumois Grain Moth, *Sitotroga cerealella* Oliv.," *Univ. California Publ. Ento.*, 1932, **5**, no. 16, 311–54, 42 text-figs.). The stocks of the parasite *Habricytus cerealella* were obtained from the Citrus Experiment Station at Riverside, California, at the close of August, 1930, where it was present as a parasite of *Sitotroga cerealella* in maize, which was being used in connection with the mass production of *Trichogramma minutum* Riley. Nothing apparently has been written concerning this parasite since its original description, and it was, therefore, decided that a study of its biology and morphology would be of value. The work was begun at the beginning of September, 1930, and was continued to the end of March, 1931. The paper includes a history of the parasite ; laboratory methods ; morphology of the adults, egg, and larva ; biology of the adults ; superparasitism ; an account of the stages of the parasitized host, egg stage, larval stages, and pre-pupal stages, etc. ; and concludes with a summary of twenty-one observations. M. E. M.

The Aphididæ of Basel and Neighbourhood.—A. O. WERDER ("Beitrag zur Kenntnis der Aphiden-Fauna von Basel and Umgebung," *Verhandlungen der Naturforschenden Gesellschaft in Basel*, 1930, **42**, 31, 1–98, 34 text-figs.). The contents include notes on the collection and preservation methods employed ; an historical account of the known local Aphididæ ; an annotated list of the families, sub-families, tribes, sub-tribes, genera, and species represented ; descriptions of many species, and a list of 111 species as the total of the known local aphid fauna. Notes are also given on the host plants which the various genera and species frequent, while a full list of the plant species with associated aphid species is provided. The paper concludes with an extensive bibliography of 141 references to the literature. M. E. M.

Insects and Humidity.—P. A. BUXTON ("Terrestrial Insects and the Humidity of the Environment," *Biological Reviews*, 1932, **7**, 275–320, 4 text-figs.). The principal issues dealt with relate to the gain of water in the adult insect, larva, and pupa ; to the loss of water ; to the water balance ; and to the effects of variance of humidity on the egg. In general the gain and loss of water

by insects is discussed, as well as the total amount in the insect's body. The majority of insects are said not to drink, but to rely largely on the water which is contained in their food. In insects which live in deserts or in dry material it is suggested that there may be a secretion of water from the atmosphere into the body of the insect. Loss of water is partly from the respiratory system by diffusion, and to some extent in some insects from the surface of the body. Certain insects can maintain a definite amount of water in the body even if external conditions change widely, others may lose relatively large quantities without being killed. The insect egg may be regarded as a separate problem. There is a mass of interesting and suggestive information in this paper, which is too extensive in its scope to be briefly summarized here. M. E. M.

Arachnida.

Russian Hydracarina.—K. Viets (" Einige Hydracarinen aus Quellen bei Moskau gesammelt von Herrn Dr. N. Decksbach," *Die Russische Hydrobiologische Zeitschrift*, 1925, **4**, nos. 3–6, 104). Records as additions to the Russian fauna *Thyas rivalis* Koen, *Thyopsis cancellata* (Protz), *Panisus michæli* (Koen), *Lebertia complexa* (Koen), *L. sefvei* Walt, and *Hygrobates norvegicus* (Sigthor). The chief interest attaching to these rests on the fact that hitherto the hydracarine fauna of Russian water sources (*Quellfauna*) has not been studied. The springs investigated were at Moscow, Svenigorod, and Woskresensk (all in Gouv. Moscou) in 1923. The reporter is obliged to Dr. Viets for a typewritten copy of his communication—separates not being issued by this not readily accessible journal. BM/HNDH

Arctic Hydracarina.—K. Viets (" Hydracarinen der Fauna Artica," *Fauna Artica*, 1931, **6**, Lief. 1, 1–8). Notes that no Hydracarina were brought home by the " Helgoland " Expedition. A summary is given of present-day knowledge of the hydracarina (including the halacarid forms) occurring in Northern latitudes. A short summary is appended of the halacarids from the Antarctic, where up to the present no fresh-water forms are known to occur. BM/HNDH

Acarids from Subterranean Sources.—K. Viets (" Die Erste Stygobionte Wassermilbe," *Archiv. für Hydrobiologie*, 1931, **23**, 677–84, figs. 1–10). Up to 1931 no representative of watermites from subterranean sources was known. While using a hand-pump Dr. S. Karaman obtained at a depth of 10–12 metres from wells at Skoplue (Jugoslavia) ♂, ♀ et ny. of *Stygohydracarus troglobius* n.g. n.sp. The new genus appears to occupy an intermediate position between Arrhenurinæ and A-Thienemanniinæ, the latter subfamily covering the genera *A-Thienemannia* Viets and *Mundamella* Viets. The creation of the new genus necessitates the separation of *Mundamella* from A-Thienemanniinæ and the erection of a new subfamily, Mundamellinæ, to embrace *Mundamella* and *Stygohydracarus*. The new genus belongs to the hard-skinned group and has the genital acetabula on plates. The nymph has the skin of a texture less hard than that of the adult form and the provisional genital area with plates for the acetabula. Concerning coloration, the body skin is transparent, without colour, and only in some places the interior organs exhibited a dirty yellow tint. Eyes appear to be wanting, as neither pigment nor lenticular swelling of the skin could be detected. Under the same conditions and in the same locality there was later found a new species belonging to a genus long known from surface waters, *Megapus subterraneus* n.sp. (K. Viets—" Weitere Milben aus unterirdischen Gewässern 1932," *Zoologischer Anzeiger*, Bd. 100, 173–6, figs. 1–3). No indication is given as to the existence of eyes or coloration. Along with this was found a representative of the Trombidiidæ,

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Stygothrombium karamani n.g., n.sp. (*ibid.*, figs. 4–8). Here also lateral eyes could not be observed and no indication is given as to colour. A third communication by Viets ("Dritte Mitterlung über Wassermilben aus Unterirdischen Gewässern, 1932," *Zoologischer Anzeiger*, Bd. 100, 292–9, figs. 1–8) adds two new genera and species, viz. *Acherontacarus halacaroides* n.g., n.sp. (subfam. Hydrovolziinæ) and *Lethaxona pygmœa* n.g., n.sp. (subfam. Axonopsinæ). In the former the eyes are wanting and the body colour is yellow ; in the latter the eyes are small and black pigmented, and the body colour is transparent yellow with a tinge of rose colour. In the case of these two latter species, it is to be noted that they were drawn up by pumping from covered wells, while in the cases noted earlier above it is understood the wells were open. As may be inferred the new generic names are derived from Styx, Acheron, and Lethe, fabled rivers of the underworld.

BM/HNDH

Australian Watermites.—K. VIETS (" Our Present Knowledge of Australian Watermites (*Hydrachnellæ et Halacaridæ*)," *Records of the Australian Museum*, 1932, **18**, no. 7, 364–7). Summarizes what is known at present of the aquatic Acarid fauna of Australia and New Zealand and of the archipelago lying to the north and north-east of the Australian continent.   BM/HNDH

Light Reactions of Watermites.—JOHN H. WELSH (" Reversal of Phototropism in a Parasitic Watermite," *Biological Bulletin*, 1930, **59**, 165–9). Describes experiments to test the light reactions of *Unionicola ypsilophorus* var. *haldemani* (Piers). Author found a positive reaction to light after removal from *Anodonta cataracta* Say, but that an extract from the gills or water from the mantle cavity caused a reversal to a photo-negative state. An attempt was made to determine the nature of the substance which causes the reversal (" Specific Influence of the Host on the Light Responses of Parasitic Watermites," *Biological Bulletin*, 1931, **61**, 497–99), and the author concluded that certain proteins or decomposition products of proteins were responsible for the reversal. He further expressed the view that the mites experimented with were probably primitively positive to light and only acquired the negative response after a long period of life within the particular species of mussel. The effect of light on the rate of progression was also studied (" Tonic Effect of Light on Unionicola," *Journal of General Physiology*, 1932, **16**, 349–55) and the author attributes the change in length of stride with changing light intensity to a tonic effect of light on the locomotor muscles. A short summary of the foregoing communication may be found in *Science*, 1932, **75**, 591–2.   BM/HNDH

Hydracarina from Kenya.—O. LUNDBLAD (" Diagnosen neuer Afrikanischer Wassermilben," *Zoologischer Anzeiger*, 1927, **70**, 328–33, 6 text-figs.). Describes as new species from Kenya *Sperchon* (Hispido.), *Elgonensis*, *S.* (Mixo.) *Fenestratus*, *Atractides jucundus*, *A. bryki*, *Hygrobates elgonensis*, *H. laceratus*, *H. lovéni*, *Megapus splendidus*, *M. ugandensis*, *M. linearis*, *Octomegapus minutissimus*, and as n.g., n.sp. *Hygrobatomegapus spathuliferus*.   BM/HNDH

Carpathian Watermites.—C. MOTAS (" Cîţiva Hidracarieni Torenticoli din Carpaţin Revista Ştiinţifică," *V. Adamachi*, 1932, **18**, no. 4). Records twenty-four species of torrenticol Hydracarids taken in the Central and Eastern Carpathians. Most of those had been formerly recorded by him from Dauphiné (France) during his stay there (1925–8), excepting *Partnunia steinmanni* Walter, which appears to be well distributed in the Carpathian area.   BM/HNDH

Wisconsin Hydracarina.—RUTH MARSHALL ("Preliminary List of the Hydracarina of Wisconsin, Part II," *Trans. Wisc. Acad. Sci. Arts. Lett.*. 1932, **27**, 339–58, pls. 7–10). Records seventeen species belonging to nine genera. One species, *Tyrrellia ovalis*, is new, and is distinguished from the genotype, *T. circularis*, by the presence of two small antero-dorsal plates, by the more elongated form of the body, and by the shape of the female genital plates. The new species also appears to be smaller. Piersig (1905), reviewing Wolcott's collections, came to the conclusion that Wolcott's *Limnesia maculata* and *L. fulgida* possessed sufficient distinctions to separate them from the European forms. and he named them *L. americana* and *L. wolcotti* respectively. After examination of much material, both European and American, Dr. Marshall finds that the differences are not of sufficient importance to justify the existence of *L. americana* and *L. wolcotti*, which are suppressed as synonyms of *L. maculata* and *L. fulgida*. Re-examination of *Limnesia elliptica* Mar. and *Hygrobates ruber* Mar. has led Dr. Marshall to reject these names in favour of *L. maculata* and *H. longipalpis*. The male of *Megapus parviscutus* Mar. is now found to have been described as *M. orthopes* Mar., which now gives place to the older name. BM/HNDH

Rotifera.

The Rotifers of Poland.—JERZY WISZNIEWSKI (VIGRI) ("Przyczynek do Znajomości Fauny Wrotków Polesia. Contribution à l'étude des Rotifères de Polésie (Pologne)" (Polish text with Summary in French), *Arch. d'Hydrobiol. d'Ichthyol.*, 1930, **5**, 265–84, 4 text-figs.). An annotated list of 108 species of rotifers found during August, 1929, in the vicinity of Pinsk in Poland. After some remarks on *Euchlanis meneta* Myers, *Wolga spinifera* (Western), and *Pedalia mira* (Hudson), the identity of *Lecane brevis* (Murray) with *L. flexilis* (Gosse) and that of *Monostyla furcata* Murray with *M. ovalis* Jakubski are discussed at greater length apropos of Polish examples. In the latter case the author considers that Jakubski's species must be regarded as identical with Murray's form, described a year earlier (1913) and having, therefore, priority. D. L. B.

Rare Rotifers in Spain.—JERZY WISZNIEWSKI (VIGRI) ("Sur quelques rotifères trouvés en Espagne," *Arch. d'Hydrobiol. d'Ichthyol.*, 1931, **6**, 41–64, 2 pls., 2 text-figs.). The author has had the opportunity of examining a series of plankton gatherings made in 1929 in or adjoining Lake Albufera in Valencia (Southern Spain) and has found in them some forty-seven species of Rotifers, many of them of considerable interest. Unfortunately the gatherings had been preserved in formalin without preceding narcotization of the living contents, so that only the few of the illoricated rotifers present, which had retained their natural extended form and were still in good condition, could be recognized. The majority of the species listed are therefore loricate, the genera *Lecane* and *Monostyla* being very strongly represented. The Rotifer fauna of Spain has hitherto been little studied and that only in recent years. Arévalo, working on the lake named, had, in 1918 listed twenty-nine species, while Pardo, following in 1925, had announced forty-five species for the whole of Spain. In the plankton material examined by him the author has found again nineteen species of these earlier listed forms, and also twenty-eight others not hitherto known to have a Spanish habitat. The whole list is remarkable for the large proportion of species which are very rare or unknown in other European countries. Among these may be noted *Tripeuchlanis plicata* (Levander), *Lecane papuana* (Murray), *L. ohioensis* (Herrick) var. *jorroi* (Arévalo), *L. crepida* Harring, *L. aculeata* (Jakubski), *Monostyla thalera* Harring & Myers, *M. obtusa* Murray, *M. furcata* Murray, *Pedalia fennica* (Levander), and

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Pedalia fennica var. *oxyuris* (Sernow). Several of these forms have previously been known only from brackish waters, but have here been met with in fresh. Much care has been taken with the preparation of the figures and of the descriptive notes.
<div align="right">D. L. B.</div>

The Rotifers of Abyssinia.—DAVID L. BRYCE (" Report on the Rotifera : Mr. Omer-Cooper's Investigation of the Abyssinian Fresh Waters (Dr. Hugh Scott Expedition)," *Proc. Zool. Soc.*, 1931, 865–78, 1 pl.). The rotifers found in a number of Plankton gatherings made by Mr. J. Omer-Cooper in the course of an expedition through the Highlands of Abyssinia in the late autumn of 1927 were interesting mainly on account of the high elevations at which the various collections were made. The elevations of the upland lakes visited ranged from 5000 to 9000 feet, and no less than forty-seven species, all belonging to the order Ploïma or Hunting Rotifers, were found to be recognizable and to be capable of life at such considerable heights. Attention is drawn to the unusual preponderance of loricated over illoricated forms, and the suggestion is made that the height above sea level of the habitat has some connection with the proportion of the two series of species. Many of the waters were of alkaline character, some undrinkable. Most of the forms recognized were known to be cosmopolitan in their distribution, but a few were less widely distributed, and among these may be mentioned *Diplois daviesiœ*, which few observers have seen dead, far less alive. The following forms have received names as new to science : *Lecane zwaiensis*, of which only one specimen was observed, *Brachionus edentatus*, and *Brachionus pala dimidiatus*, the two latter being of unusually small size for their genus. *Brachionus pala dimidiatus* was found both in fresh water and in alkaline waters, but *B. edentatus* only in alkaline.
<div align="right">D. L. B.</div>

Some Rotifers from the North of England.—B. MILLARD GRIFFITHS and F. E. COCKS (" The Rotifers of the Northumberland Plankton," *Trans. North. Nat. Un.*, 1931, **1**, 45–7). A list of the rotifers found in Plankton gatherings from sixteen lakes, reservoirs, and pools in Northumberland and one pool in Durham. It is emphasized that the list contains only those rotifers which occur in the open water, and does not include the many species which are sedentary or occur among aquatic or damp vegetation. While the majority of the forty-nine forms listed are well known and widely distributed throughout Europe, the authors consider the following species noteworthy as rarities : *Conochiloides dossuarius*, *Gastropus stylifer*, *Keratella serrulata*, *Lecane ligona*, *Plœsoma hudsoni*, *Polyarthra euryptera*, and *Testudinella parva*. Those interested in the distribution of rotifers in this country, and more especially in the distribution of particular or rare forms, will welcome this little paper as a useful contribution to our knowledge of the British Rotifer-Fauna.
<div align="right">D. L. B.</div>

Some New Rotifers from Central Africa and from Alsace.—P. DE BEAUCHAMP (" Reports on the Percy Sladen Expedition to some Rift Valley Lakes in Kenya in 1929. III. Rotifères des Lacs de la Vallée du Rift," *Ann. Mag. Nat. Hist.*, Ser. 10, 1932, **9**, 158–65, 3 text-figs.). The results of the examination of a set of Plankton gatherings made by Miss Penelope Jenkin in the lakes of the Rift Valley, visited in 1929 by the Percy Sladen Expedition, are set forth in a short report. The most varied list of forms came from the three fresh-water lakes, but all were already well known and most of them frequent in European habitats. From the two alkaline lakes, however, came only four species in all, but these comprised a new species of Pedalia, *P. jenkinœ*, of unusually small size and apparently of feeble development, together with a new Cephalodella, *C. elmenteita*, nearly

allied to *C. catellina,* but of considerably larger size and appearing to lack the pair of frontal eyes characteristic of the more widely spread form. Both of these were met with in Lake Elmenteita in small numbers, accompanied by numerous examples of *Brachionus plicatilis* and of *Brachionus pala dimidiatus,* recently detected in the alkaline lakes of Abyssinia, and these latter forms were also present in the plankton of Lake Nakuru. Apropos of the last named the author gives particulars, under the name of *Brachionus pala brycei* n. var., of a nearly related form, which he has become acquainted with in Alsace.   D. L. B.

Plankton Rotifera from Mexico.—ELBERT H. AHLSTROM (" Plankton Rotatoria from Mexico," *Trans. Amer. Micr. Soc.,* 1932, **51,** 242–51, 1 pl.). With few exceptions the rotifers listed in this short paper were obtained from three townettings made in the Rio Grande de Santiago, the Rio Lerma, and the Rio Salto, during March and April of last year. From these limited materials an interesting first list of Mexican rotifera, containing the names of some sixty-three species or varieties, has been compiled. While most of these are cosmopolitan in their distribution, quite a large proportion are noteworthy for their rarity. Foremost among these stands out *Euchlanis lucksiana* Hauer, recently detected in Germany, which resembles *Euchlanis parva* Rousselet, but has much shorter toes and a posterior notch only half as deep as in that species. In the Rio Salto *Brachionus budapestinensis* Daday was abundant and *Brachionus havanaensis* Rousselet was scarce and of small dimensions. *Brachionus trahea* Murray occurred sparingly in the Rio Santiago accompanied by several examples of *Conochiloides natans* Seligo and of *Cephalodella panarista* Myers, whilst a single example of *Dapidia calpidia* Myers was present in the Rio Lerma netting. A new variety of *Testudinella cœca* Parsons was represented by two examples in the same netting and has been given the name of *lermœnsis* var. n. The specimens of *Tetramastix opoliensis* Zacharias found abundantly in the tow from the Rio Santiago differed from the type in having the posterior ventral spine much reduced, viz. to about one-tenth of the normal length, and it has been thought well to award it the name of *brevispina* var. n.   D. L. B.

<div align="center">Protozoa.</div>

Fertilization in Plasmodium.—E. MARCHOUX and V. CHORINE (" La fécondation des gamètes d'hématozoaires," *Ann. Inst. Pasteur,* **49,** 1932, 74). Working with the parasites of bird malaria, *Hœmoproteus oryzivorœ* of *Padda oryzivora* and *H. columbœ* of the pigeon, the authors conducted a series of experiments and observations on the conditions under which fertilization takes place between the gametes of these parasites *in vitro.* The temperature at which this proceeds was found to be between 13° and 43° C., with an optimum of 36°. Ookinetes are produced at 20°–23° C., but they degenerate at 37°. The concentration of the fluid has no special effect upon fertilization, but very dilute or strong solutions of sodium chloride have an inhibitory action. Carbon dioxide also has an inhibitory effect on fertilization. This is due to alterations in the pH of the blood which it produces. Normally the pH of pigeon's blood is 7·34–7·35 ; fertilization does not take place before it reaches 7·55. Fertilization can take place in the absence of oxygen and in an atmosphere of hydrogen. Anti-malarial drugs were found to act as follows : 0·0001 quinine hydrochloride retards fertilization, while 0·001 stops it almost completely. Plasmoquine and Fourneau 710 act in the same way at the respective concentrations of 0·0001 and 0·00025.   C. A. H.

A New Avian Trichomonas.—B. V. TRAVIS (" *Trichomonas phasiani,* a New Flagellate from the Ring-necked Pheasant, *Phasianus torquatus* Gmelin," *J.*

Parasit., **18**, 1932, 285, 1 pl.). Description of a new intestinal flagellate, *Trichomonas phasiani* sp.n., from an American pheasant, *Phasianus torquatus.*

C. A. H.

Nuclear Structure of Endolimax.—R. M. STABLER ("On the Presence of Peripheral Chromatin in *Endolimax nana,*" *J. Parasit.*, **18**, 1932, 278, 1 fig.). The human intestinal amœba, *Endolimax nana,* is usually characterized by the absence of peripheral chromatin in its nucleus. In this paper it is shown that by fixing the amœbæ with Schaudinn's fluid to which 5 p.c. glacial acetic acid is added the typical nuclear structure is revealed, but if 20 p.c. acid is used, a definite ring of peripheral chromatin appears on the nuclear membrane, while the karyosome retains hæmatoxylin poorly. The presence of peripheral chromatin would indicate a closer relationship between *Endolimax* and *Entamœba.* C. A. H.

Amœbæ from China.—C. C. WANG ("Notes on Amœba and Its Allies of Nanking," *Contrib. Biol. Lab. Sci. Soc. China, Zool. Ser.*, **8**, 1932, 113, 14 figs.). Description of various free-living amœbæ found in Nanking, with a new form. *Amœba hohuensis* sp.n. C. A. H.

A New Termite Flagellate.—F. H. CONNELL ("*Gigantomonas lighti* sp. nov., a Trichomonad Flagellate from *Kalotermes* (*Paraneotermes*) *simplicicornis* Banks," *Univ. California Publ. Zool.*, **37**, 1932, 153, 2 pls., 3 text-figs.). Description of the morphology and mitotic division in a new flagellate, *Gigantomonas lighti* sp.n.,) parasitic in the intestine of an American termite, *Kalotermes* (*Paraneotermes*) *simplicicornis.* This flagellate is piriform, and varies in length from 47 to 91μ, and from 21 to 58μ in breadth. There are three anterior flagella which are fused in life to form a whip; while a fourth, which is longer and stouter than the rest, runs along the edge of the undulating membrane. The latter follows the external margin of the intracytoplasmic, undulatory crest with which its base is fused. The flagella and crest arise from a single blepharoplast. The blepharoplast and centrosome, though closely associated, do not form a centroblepharoplast. Nucleus piriform, with karyosome, supported by capitulum. Parabasal body cylindrical. There is a detailed account of the mitotic process. A comparative table, as well as diagnoses, of the recognized species of *Gigantomonas* is given. The genera *Myxomonas* Dogiel and *Macrotrichomonas* Grassi are regarded as synonyms of *Gigantomonas.* C. A. H.

Opalinid Infections in Frogs.—R. HEGNER ("Observations and Experiments on the Opalinid Ciliates of the Green Frog," *J. Parasit.*, **28**, 1932, 275). It has been observed that the tadpoles of green frogs are heavily infected with opalinid ciliates, whereas the adults are free from these parasites. The observations recorded were directed towards the solution of the questions: (1) When and why do the tadpoles lose their opalinids? and (2) Why do not the adults become reinfected? It was found that the tadpoles lose their parasites during metamorphosis between the two-legged and four-legged stages. The motile ciliates from the rectum of the tadpoles are unable to pass through the stomach and intestine of metamorphosed frogs and to reach the rectum in a viable condition. Opalinids of tadpoles injected directly into the rectum of the frog are unable to set up an infection. It is suggested that the intestinal secretions of the green frog render the rectum of this species unfavourable for opalinids. C. A. H.

Parasitic Ciliates from Sea-urchins.—R. B. BIGGAR and D. H. WENRICH ("Studies on Ciliates from Bermuda Sea-urchins," *J. Parasit.*, **18**, 1932, 253, 1 pl.).

Description of some new holotrichous ciliates parasitic in the intestine of sea-urchins from Bermuda. *Metopus circumlabens* sp.n. from *Diadema setosum* and *Echinometris subangularis*. *Cryptochilum bermudensis* sp.n. from *Toxopneustes variegatus*, and *C. echinometris* sp.n. from *E. subangularis*. *Anophrys elongata* sp.n. from the two last-named hosts. ,　　　　　　　　　　C. A. H.

15,300 Generations of Paramecium.—L. L. WOODRUFF (" *Paramecium aurelia* in Pedigree Culture for Twenty-five Years," *Trans. Amer. Micr. Soc.*, 51. 1932, 196). In 1907 the author started a single-line pedigree culture of *Paramœcium aurelia*, with the object of ascertaining whether protozoa were capable of reproducing indefinitely without recourse to fertilization. Up to 1915 the cultures were maintained under conditions of rigid control as follows : A number of individuals resulting from division were isolated daily : the reproductive activity of the culture was recorded at each isolation ; permanent preparations were made of some of the individuals every day for the study of the cytological changes : only sterilized culture medium was used in the experiment ; the occurrence of conjugation was precluded by almost daily isolation of the products of division. In this manner the pedigree culture was carried for eight years, during which 5071 generations were obtained. It was concluded that a unicellular organism was capable of reproducing itself indefinitely, under favourable conditions, without recourse to fertilization. The pedigree culture was continued under less exacting control for another seventeen years, attaining 15,300 generations (1932). Periodical tests during the period of experiment showed that the strain had lost none of its original vitality. 　　　　　　　　　　C. A. H.

" **Blackhead " in Turkeys.**—E. E. TYZZER (" Problems and Observations concerning the Transmission of Blackhead Infection in Turkeys," *Proc. Amer. Phil. Soc.*, 71, 1932, 407). Discussion of our present knowledge regarding the transmission of " blackhead " infection · in turkeys. This disease, caused by a flagellate, *Histomonas meleagris*, is fatal to turkeys, but usually causes a mild infection in domestic fowl. Though the latter recover, the parasites do not disappear from their body, but continue to multiply in their cæcal contents for indefinite periods and are passed daily in great numbers with their droppings. The fowl thus becomes a " carrier " of the infection. It has been shown that the disease in turkeys is derived from common poultry, the former infecting themselves when kept together with or ranging over ground previously occupied by poultry. The occurrence of the disease in young turkeys that have never been associated with chickens or older turkeys is due to a different cause. It was found that the infection is introduced into the eggs of *Heterakis gallinæ*, a round worm parasitic in the cæcum of poultry. The wide dissemination of the worm eggs over the soil explains how the infection is acquired by young turkeys reared apart from older stock. This method of transmission is facilitated by the fact that the blackhead parasite survives for long periods in the egg of the worm, while it perishes rapidly in the fæcal discharges of the fowl. It is concluded that the chicken is the natural host of the blackhead parasite. 　　　　　　　　　　C. A. H.

A Toxoplasm of the Ferret.—F. COUTELEN (" Existence d'une toxoplasmose spontanée et généralisée chez le furet. Un toxoplasme nouveau, *Toxoplasma laidlawi* n.sp., parasite de *Mustela (Putorius) putorius* var. *furo*," *C. R. Soc. Biol.*, 111, 1932, 284). Description of a new species of toxoplasms, *Toxoplasma laidlawi* sp.n., parasitic in English ferrets. The sporozoa were found in the brain, lungs, liver, and kidneys of these animals. The toxoplasms are ovoid or crescentic in shape, measuring on the average from $3 \times 2\mu$ to $4 \times 1.5\mu$. They are usually found in groups within

the host-cells where they multiply by binary fission, using up the entire contents of the cell, which is ultimately reduced to a membrane (pseudo-cyst) around the parasite.   C. A. H.

Coccidian Oocysts.—D. P. HENRY (" The Oocyst Wall in the Genus *Eimeria*," *Univ. California Publ. Zool.*, 37, 1932, 269, 2 pls.). A comparative description of the structure of the oocyst wall in various members of the coccidian genus *Eimeria*, based on literary data and personal observations of the author. The appearance of the wall being one of the diagnostic characters, the various species are grouped according to the thickness, uniformity, texture, colour, and other peculiarities of the oocyst.   C. A. H.

A New Bird Coccidium.—D. P. HENRY (" *Isospora buteonis* sp.nov., from the Hawk and Owl, and Notes on *Isospora lacazii* (Labbé) in Birds," *Univ. California Publ. Zool.*, 37, 1932, 291, 1 pl.). A new coccidium, *Isospora buteonis* sp.n., was found in the intestinal contents of some hawks, *Buteo borealis, B. swainsoni, Accipiter cooperii*, and in an owl, *Asio flammeus*, in California. The oocysts measure $16 \cdot 0{-}19 \cdot 2\mu \times 12 \cdot 8{-}16 \cdot 0\mu$. The oocyst wall is very thin and fragile, enclosing the sporocysts very tightly (as in *I. bigemina* of cats and dogs). Sporulation is completed inside the host and usually fully developed sporocysts are found in the intestinal contents, the oocysts having ruptured. The sporocysts measure $9 \cdot 6{-}13 \cdot 0\mu \times 8 \cdot 0{-}10 \cdot 4\mu$. The sporocystic residue is large and dispersed. An examination of 167 birds revealed in many an infection with *I. lacazii* conforming to Labbé's description. A list of coccidia described from birds is appended.
                                                                C. A. H.

New Mammalian Coccidia.—D. P. HENRY (" Observations on Coccidia of Small Mammals in California, with Descriptions of Seven New Species," *Univ. California Publ. Zool.*, 37, 1932, 279, 2 pls.). Description of seven new species of coccidia of the genus *Eimeria* from various California mammals. *E. beecheyi* sp.n. from the ground squirrel, *Citellus beecheyi* (oocysts, $16 \cdot 0{-}22 \cdot 4\mu \times 10 \cdot 2{-}12 \cdot 8\mu$; sporulation time 4–5 days; oocystic residue absent). In another ground squirrel, *Callospermophilus chrysodeirus*, two new coccidia were found : *E. callospermophili* sp.n. (oocysts, $16 \cdot 0{-}22 \cdot 4\mu \times 16 \cdot 0{-}22 \cdot 4\mu$; sporulation 6–7 days; oocystic residue present) and *E. bilamellata* (oocysts, $25 \cdot 6{-}35 \cdot 6\mu \times 22 \cdot 4{-}25 \cdot 6\mu$; residual body absent). Two species occurred in the wood rat, *Neotoma fuscipes : E. neotomæ* sp.n. (oocysts, $16 \cdot 0{-}22 \cdot 4\mu \times 12 \cdot 8{-}19 \cdot 2\mu$; sporulation 2 days) and *E. residua* sp.n. (oocysts, $22 \cdot 4{-}28 \cdot 8\mu \times 19 \cdot 2{-}25 \cdot 6\mu$; sporulation 8–9 days; oocystic residue present). *E. scapani* sp.n. from a mole, *Scapanus latimanus* (oocysts, $16 \cdot 0{-}22 \cdot 4\mu \times 14 \cdot 4{-}16 \cdot 0\mu$; sporulation 5 days). *E. soricis* sp.n. from a shrew, *Sorex californicus* (oocysts, $19 \cdot 2{-}22 \cdot 4\mu \times 12 \cdot 8{-}14 \cdot 4\mu$; sporulation 7–8 days). Previously described coccidia from the jack rabbit, grey squirrel, and cats are reported for the first time from California.   C. A. H.

East Anglian Fossils.—W. A. MACFADYEN (" Foraminifera from some Late Pliocene and Glacial Deposits of East Anglia," *Geol. Mag.*, 1932, 59, 481–97, pl. 34–5). Eleven out of twelve samples of East Anglian Uppermost Pliocene and Pleistocene crag, clays, boulder clays, brick-earths, and sands yielded foraminiferal faunas partly derived from older deposits. One hundred and thirty-one species were recorded, of which thirty-nine are considered indigenous, one derived from the Lower Pliocene, fifty-eight from the chalk, eighteen from the Jurassic and sixteen of doubtful age. No new species were observed. The two plates contain excellent figures of twenty-seven species, mostly indigenous. The climatic con-

ditions under which the deposits were laid down are discussed. The Weybourn Crag fauna points to cold conditions, and the Chillesford Beds to a rather milder climate. No very precise conclusions are possible in the case of the Pleistocene deposits as the faunas contain a few species characteristic of temperate or warm conditions in addition to typically boreal species.   A. E.

Fossils from Southern Alberta.—R. T. D. WICKENDEN ("A Useful Foraminifera Horizon in the Alberta Shale of Southern Alberta," *J. Palæont.*, 1932, **6**, no. 2, 203–7, pl. 29). Means of making accurate correlations for structural determination in drilling for oil in Southern Alberta are few. But the Alberta shale contains numerous foraminifera at various horizons, which with care can be used for making accurate correlations. The species described in the paper come from a zone about 200 feet thick, the upper limit of which is about 300 feet below the top of the Alberta shale. Only eight species of the twenty recorded from the zone are described, these being selected because they are easily recognized and occur in all the wells examined. The species are adequately illustrated.   A. E.

Recent Foraminifera from Gulf of Mexico.—M. M. KORNFELD (" Recent Littoral Foraminifera from Texas and Louisiana," *Cont. Dep. Geol. Stanford Univ.*, 1931, **1**, no. 3, 77–91, pls. 13–16, 2 maps). Material was collected from beaches at eighty stations in the Gulf of Mexico between the Mississippi and the Rio Grande, and twenty-seven of these stations were selected for examination. There are no marked differences between the faunas of the open coast and those of the long cays lying off the mainland, but the Foraminifera become less abundant in the embayments, and arenaceous types tend to prevail over the calcareous types. On the open coast these selections are reversed. Twelve species and varieties are listed and well illustrated, including five new varieties. Many of the forms recorded are already known from the Miocene and subsequent deposits of the Gulf Region.
                                                                                                A. E.

Arenaceous Foraminifera from Miocene of California.—J. A. CUSHMAN and W. F. BARBAT (" Notes on some Arenaceous Foraminifera from the Temblor Formation of California," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 119, 29–40, pls. 4–5. Records and figures thirteen species and varieties, including one new species and one new variety of *Gaudryina*. The paper is largely geological, and one of the plates is devoted to a section of the strata through which the well was drilled from which the material was obtained.   A. E.

New Eocene Foraminifera.—J. A. CUSHMAN and A. C. ELLISOR (" Additional New Eocene Foraminifera," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 120, 40–3, figs. 1–6 on pl. 6). Four new species and two new varieties are figured and described from the Upper Eocene (Jackson) of Texas and Louisiana. Some of them appear to be closely related to other known species of the Eocene and Oligocene, but are rather strictly limited in their vertical distribution and therefore of value as zone markers.   A. E.

Pacific Forms of Angulogerina.—J. A. CUSHMAN (" Some Recent *Angulogerinas* from the Eastern Pacific," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 121, 44–8, figs. 7–16 on pl. 6). An "Albatross" Station H1805, off the west coast of Mexico in 1732 fathoms has a very interesting foraminiferal fauna, including abundant specimens of *Angulogerina*. One new species and two new varieties of that genus are figured and described.   A. E.

Eocene of Alabama.—J. A. CUSHMAN and G. M. PONTON (" An Eocene Foraminiferal Fauna of Wilcox Age from Alabama," *Cont. Cush. Lab. For. Res.*,

1932, **8**, no. 122, 51–72, pls. 7–9). This is stated to be a preliminary report on the fauna of the Wilcox strata of which no complete fauna has been published. Forty-eight species and varieties, including nineteen new species are described and figured. The fauna bears considerable resemblance to that described by Schwager from the Middle Eocene of Northern Africa. There are no imperforate species and only a single arenaceous species in the list. . A. E.

The Genus Vulvulina.—J. A. CUSHMAN (" The Genus *Vulvulina* and its Species," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 123, 75–85, pl. 10). The genus was created by d'Orbigny in 1826, and many species have since been described under various generic names, which appear to be attributable to it. It has a range from the Eocene upwards, and certain species and varieties have definite geological ranges and geographical distribution. The paper which is full of interesting data as to range and distribution, includes descriptions and figures of three new species and two new varieties. A. E.

Cretaceous Textulariæ.—J. A. CUSHMAN (" *Textularia* and Related Forms from the Cretaceous," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 124, 86–97, figs. 1–14 on pl. 11). The author has been studying European collections of Cretaceous types. His experience confirms the opinion already held that many American Cretaceous species are identical with those of Europe. Many of the earlier described species have been figured and described so inadequately that they have not been placed in their proper generic position, and subsequent identifications are often incorrect. The paper, which defies abstraction, deals with the species which have been assigned to *Textularia* in their order of original publication, gives the author's notes on the original types and topotypes, and assigns them to their real generic position. It will occasion much reassessment of nomenclature. A. E.

Relationships of Textulariella.—J. A. CUSHMAN (" The Relationships of *Textulariella* and Description of a New Species," *Cont. Cush. Lab. For. Res.*, 1932. **8**. 97–8, figs. 17–19 on pl. 11). The genus *Textulariella* was created by the author for the species *Textularia barrettii* Jones & Parker, 1863, well known from the Recent and Miocene of the West Indian Region. This has biserial chambers with labyrinthic interiors. A new species, *Textulariella cretosa*, from the chalk detritus of Charing, Kent, has the same characters, but the early chambers are triserial. Re-examination of a series of specimens of *Textularia barrettii* has shown that the earliest stages of that species are also triserial and the genus *Textulariella* should apparently be transferred to the Family Verneuilinidæ. A. E.

Two New Species from Cretaceous of Texas.—J. A. CUSHMAN (" Two New Navarro Foraminifera from Texas," *Cont. Cush. Lab. For. Res.*, 1932, **8**, no. 126, 98–9, figs. 15–6, 20–1 on pl. 11). Describes and figures *Gaudryina navar-roana* and *Gaudryinella pseudoserrata*, both of which are stated to be abundant in the Upper Cretaceous (Navarro) of Texas, and to be regarded as excellent index-fossils for their respective zones. A. E. '

Ultramicroscopic Viruses.

Intranuclear Inclusions in Human Nerve Cells.—A. WOLF and S. T. ORTON (" The Occurrence of Intranuclear Inclusions in Human Nerve Cells in a Variety of Diseases," *Bull. Neurol. Inst. of New York*, 1932, **2**, 194). Acidophilic inclusions in the nucleoplasm of human nerve cells have been found not only in

anterior poliomyelitis but in a wide variety of diseases. The inclusions are therefore probably of a non-specific character, unless the human brain is the site of infection with a not uncommon virus of low pathogenicity. G. M. F.

The Cytology of Infectious Myxoma of the Rabbit.—M. R. Lewis and R. E. Gardner ("A Simple Method for Studying the Cytology of the Infectious Myxoma of the Rabbit," *Amer. J. Path.*, 1932, 8, 583). Smears of the tumours are made on cover-glasses and placed for from 1 to 10 minutes in undiluted Wright's stain, thence into a dish with stain and half the amount of distilled water for from 2 to 10 minutes, blotted, not dried, passed rapidly through two changes of absolute alcohol into xylol, thence into clean xylol, from which they are mounted in balsam on a slide. The greatly hypertrophied spindle and stillate cells showed with great clearness. G. M. F.

The Size of the Virus of Herpes.—W. J. Elford, J. R. Perdrau and W. Smith ("The Filtration of Herpes Virus through Graded Collodion Membranes," *J. Path. and Bact.*, 1933, 36, 49–54). Filtration experiments through graded collodion membranes show that both the cerebral and testicular strains of herpes virus have a probable size of from $0\cdot1$ to $0\cdot15\mu$. It should therefore be possible to photograph herpes virus by means of ultra-violet light. G. M. F.

A Developmental Cycle in the Virus of Psittacosis.—S. P. Bedson and J. O. W. Bland ("A Morphological Study of Psittacosis Virus with the Description of a Developmental Cycle," *Brit. J. Exp. Path.*, 1932, 13, 461, 2 pls.). A cycle in the development of the psittacosis virus is described and figured. Such a cycle-elementary body→amœboid forms running together to form a plasmodium→morula→division and subdivision of elements of morula→elementary body—carries with it the implication that the virus is not a bacterium, but possesses affinities with the mycetozoa or myxomycetes, or possibly with the microsporidia. G. M. F.

BOTANY.

GENERAL.

Cytology.

Chromosomes in Taxus and other Gymnosperms.—S. O. S. DARK ("Chromosomes of *Taxus, Sequoia, Cryptomeria* and *Thuya*," *Ann. Bot.*, 1932, **46**, 965–77). The following chromosome counts for species and varieties were obtained : *Taxus baccata* 2n = 24, n = 12, *T.b. fastigiata* n = 12, *T.b. adpressa aurea* n = 12, *T. cuspidata* 2n = 24, *T.c. contorta* 2n = 24, *T. canadensis* var. *aurea* n = 12 + 1, *Sequoia sempervirens* 2n = ca. 50, *Cryptomeria japonica* 2n = 24, *Thuya occidentalis* 2n = 24. Root-tips are unfavourable material for study owing to crowding of the very elongated chromosomes. Meiosis is described for *Taxus baccata* with no irregularities. The chiasma frequency at metaphase is low and terminalization incomplete. *T. canadensis* differs from the other forms examined in having a small extra chromosome assumed to have arisen as a fragment. Attempts to examine root-tips have been unsuccessful. *Sequoia sempervirens* is considered to be a tetraploid species. J. S.

Chromosomes of Lycopersicum.—L. M. HUMPHREY ("The Chromosomes of *Lycopersicum pimpinellifolium*," *Amer. J. Bot.*, 1932, **19**, 812–13). The red currant tomato, *Lycopersicum pimpinellifolium*, agrees in haploid chromosome number n = 12 with the common tomato *L. esculentum*. Measurements were made of the homotypic chromosomes in both species, those of *L. esculentum* having an average diameter of 1·12μ, those of *L. pimpinellifolium* 0·77μ. The mature pollen grains and all morphological features of the latter species are also much smaller than those of *L. esculentum*. J. S.

Chromosomes of Anchusa.—S. G. SMITH ("Cytology of Anchusa and its Relation to the Taxonomy of the Genus," *Bot. Gaz.*, 1932, **94**, 394–403). The following chromosome numbers have been determined : *Anchusa barrelieri* 2n = 16, *A. capensis* 2n = 16, *A. hybrida* 2n = 16, *A. officinalis* 2n = 16, *A. ochroleuca* 2n = 24, *A. italica* 2n = 32. *A. italica* vars. Pride of Dover, Dropmore, and Opal 2n = 32, *Brunnera macrophylla* 2n = 12, and *Caryolopha sempervirens* 2n = 32. *A. italica* and its varieties are shown to be allotetraploids. The origin of the triploid *A. ochroleuca* is discussed. On cytological grounds the segregation by Johnston of both *Anchusa myosotidiflora* and *A. sempervirens* into other genera as *Brunnera macrophylla* and *Caryolopha sempervirens* is completely substantiated by the number and character of their somatic chromosomes. J. S.

Chromosome Numbers in Hemerocallis.—A. B. STOUT ("Chromosome Numbers in *Hemerocallis*, with Reference to Triploidy and Secondary Polyploidy," *Cytologia*, 1932, **3**, 250–9). Twenty-two somatic chromosomes are present in the root-tip cells of the following species of *Hemerocallis* : *H. flava, H. minor, H. Dumortierii, H. middendorffi, H. aurantiaca, H. Thunbergii, H. citrina, H. Forrestii,*

H. multiflora, H. nana, and *H. plicata.* Several clons of cultivated fulvous day-lilies are triploids and some show considerable variation in chromosome number both in somatic and pollen-mother cells. The triploid clons comprise the single-flowered *Europa* and *Maculata* day-lilies, and the double-flowered types known by the names *Kwanso, Flore Pleno,* and *Variegated.* These types all obviously belong to the somewhat variable wild species *H. fulva,* but their origin is not definitely known. Chromosome counts from root-tips show 33 to be the most usual somatic number. The triploids show great abortion of pollen and also complete self- and cross-incompatibility for spores and gametes which are shown to be functional when the triploids are crossed with diploids. No seedlings have been obtained from self- or cross-pollinations involving only triploids. Chromosome counts have been made of forty-four seedlings obtained from crossing triploids with diploids. The majority of these seedlings are diploids, a few triploids and several are aneuploids with somatic numbers fluctuating between the diploid and triploid. This indicates that the functional gametes in the triploid day-lilies most frequently carry eleven chromosomes, but the number may vary and rise to at least twenty-two. Following a discussion on secondary polyploidy, the author suggests that the haploid number 11 has been developed from a basic group of six of which five were duplicated. J. S.

Microsporogenesis in Phoradendron.—F. H. BILLINGS ("Microsporogenesis in Phoradendron," *Ann. Bot.,* 1932, **46,** 979–92). The following three species of the American mistletoe have been studied : *Phoradendron flavescens* Nutt. var. *macrophyllum* Engelm., *P. villosum* Nutt., both of which flower most of the year, and the desert species *P. californicum* which blossoms in early spring. In all three species the male and female plants grow in close association. The development of the sporogenous tissue is described. Several peculiarities were observed in material collected in the winter : no simultaneous heterotypic divisions within the same anther, no regular tetrads of microspores, mother-cells functioning as tapetal cells. Normal meiosis with occasional extrusion of nucleoli and chromatin was seen in spring and summer material. In the staminate plants ten chromosomes pass to one pole, eleven to the other at first anaphase, and twenty-one chromosomes are seen in somatic nuclei. In the carpellate plant ten chromosomes pass to each pole, the somatic cells containing twenty chromosomes. Defective pollen is found in all anthers varying from 30 p.c. in *P. californicum* to 40–45 p.c. in *P. flavescens* and *P. villorum,* or complete abortion may occur in some anthers of all three species. J. S.

Megasporogenesis in Cotton.—U. R. GORE ("Development of the Female Gametophyte and Embryo in Cotton," *Amer. J. Bot.,* 1932, **19,** 795–807). The development of the female gametophyte and early stages of embryo development are described in Sea Island Cotton (*Gossypium barbadense* L.), Pima (*G. peruvianum* Cav.), and Upland (*G. hirsutum* L.). The chalazal megaspore gives rise to the embryo-sac, which, when mature, is very elongated and embedded in many layers of nucellus. There is early degeneration of the antipodals, and the polar nuclei start to fuse before the entrance of the male gametes. The pollen-tube enters the ovule 15–20 hours after pollination, and fertilization is completed from 24 to 30 hours after opening of the flower. Various methods of triple fusion are reported. The author also gives his results of a study of the comparative stages of bud development on several fruiting branches of any one plant. From such studies can be predicted with reasonable certainty the stage of development of internal organs for any bud before collecting material. J. S.

Genetic Analysis of Œnotheras.—R. R. GATES and D. G. CATCHESIDE ("Gamolysis of Various New Œnotheras," *J. Genetics*, 1932, **26**, 143–78). The paper contains an analysis into their complexes of the five species *O. eriensis, novæ-scotiæ, angustissima, nutans*, and *pycnocarpa*. The results are obtained from numerous F_1 crosses with each other and with the homozygous forms *deserens, blandina*, and *purpurata*, as well as the latter with each other. Certain double reciprocal hybrids of these species showing complete reversion to the original parents are also included, and a few crosses with *O. ammophila*. The breeding behaviour of *O. (Raimannia) Agari* is also discussed. The five species analysed are all heterogamous, *pycnocarpa* being incompletely so, while in *eriensis* and *angustissima* both complexes may function on the female side. Observations on the seeds and pollen indicate the presence of zygotic and gametic lethals in various cases. The non-viable condition of half the pollen in F_1 species-hybrids is considered due to lack of harmony between the chromosome complex and its associated cytoplasm, rather than to a single gene. The chromosome catenations in a large number of the F_1 hybrids are given in tabular form, and deductions are drawn from them regarding the chromosome content of different species. *O. angustissima* represents a novel genetic condition in that the complex *divergens* functions in a majority of the ovules and in all the pollen grains. It is suggested that *O. angustissima* is descended from crosses between the sub-genera *Raimannia* and *Onagra*. Certain relationships between the species are discussed on the basis of their complexes and catenations.   J. S.

Fixation and Chromosome Structure in Lathyrus.—J. LATTER ("The Effect of Fixatives on the Prophase Stages and Heterotypic Chromosomes of *Lathyrus odoratus*," *Ann. Bot.*, **46**, 807–11). The method of fixation has a marked effect on the appearances observed in the prophase and first metaphase stages of microsporogenesis in *Lathyrus odoratus*. According to the fixative employed, the events in prophase may agree either with a completely telosynaptic or a partly parasynaptic interpretation of the mode of chromosome pairing. It appears that a preliminary treatment with Carnoy's fluid is the deciding factor in obtaining fixation of *L. odoratus* which shows certain threads pairing side by side. The metaphase and early anaphase chromosomes in material fixed in Allen's Bouin, 1 p.c. chrome-acetic, acetic alcohol, strong Flemming, Merkel or Hermann's fluids are compact structureless bodies, while those in Carnoy-Navashin and Carnoy-Flemming fixatives show several types of configuration and clear spiral structure.
                                                                      J. S.

Cytology of Parthenogenetic Species of Antennaria.—G. L. STEBBINS ("Cytology of *Antennaria*. II. Parthenogenetic Species," *Bot. Gaz.*, 1932, **94**, 322–45). Seven parthenogenetic species of *Antennaria* have been studied, with the following diploid chromosome numbers : *A. fallax* 84, *A. occidentalis* 75–85, *A. parlinii* 84, *A. canadensis* 83–86, *A. petaloidea* 75–80, *A. neodioica* ca. 52, *A. Brainerdii* 42. The staminate plants are rare or unknown ; in only *A. fallax, A. parlinii*, and *A. canadensis* was material available for the study of pollen development which is described for these species with many irregularities. In the pistillate flowers of all the species studied, the embryo-sac usually originates directly from an unreduced megaspore mother-cell and the egg-cell develops without fertilization into an embryo. Occasionally the megaspore mother-cell undergoes an abnormal reduction division resulting in three nuclei, which after the second division form a hexad or other polysporic group of nuclei which degenerate. In their irregular meiosis, these parthenogenetic species resemble other apomictic

forms and known hybrids. The species are all allopolyploids resembling those which have originated through interspecific or intergeneric crossing. Some are morphologically intermediate between the normal species. The parthenogenetic species have most likely originated from crosses between existing or extinct normal, sexually reproducing species. Various extra-chromosomal irregularities of meiosis are discussed.   J. S.

Meiosis in Hemerocallis.—S. O. S. Dark (" Meiosis in Diploid and Triploid *Hemerocallis*," *New Phyt.*, 1932, **31**, 310–20). Meiosis in the pollen mother-cells was studied in the diploid species *H. aurantiaca*, *H. flava*, *H. Elmusæ*, and *H. vermusæ* (2n = 22), and in the triploid *H. fulva* var. *Kwanso* (2n = 33). The author shows that the structure of the pairing chromosomes can be explained in terms of the relationship of the chromatids at chiasmata, and their behaviour at anaphase can be interpreted on the same basis. In the triploid at metaphase there are generally five or six trivalents present with six or five univalents and bivalents. The fact that a varying number of trivalents is formed is to be expected on the basis of the chiasma theory of metaphase pairing.   J. S.

Reciprocal Crosses of Avena.—H. Kihara and I. Nishiyama (" The Genetics and Cytology of Certain Cereals. III. Different Compatibility in Reciprocal Crosses of *Avena*, with Special Reference to Tetraploid Hybrids between Hexaploid and Diploid Species," *Jap. J. Bot.*, 1932, **6**, 245–305). The three different karyological groups in the genus *Avena* have 7, 14, and 21 haploid chromosomes respectively. Interspecific crosses succeed easily between any two *Avena* species with the same chromosome number. No offspring have been obtained from the cross 7-($♀$) × 14-chromosome species ($♂$) though the reciprocal cross produces seed with from 72 to 100 p.c. germination. No viable seeds were produced from the 7-($♀$) × 21-chromosome species ($♂$). A few weakly developed seeds were formed from the reciprocal cross giving 50–73 p.c. germination. The reciprocal crosses between 14- and 21-chromosome species gave well-formed seeds with high percentage germination. The results of crossing and germination experiments between different species are given in detail in tabular form. Two tetraploid F_1 hybrids *A. sativa* × *strigosa* and *A. fatua* × *strigosa* have been studied. Both are completely self-sterile. The meiotic behaviour is similar in both and is described in detail with the aid of twenty-eight text-figures. Two to nine bivalents are usually present at first metaphase; many pollen-mother-cells have one to four trivalents and sometimes chromosome complexes of four to eight elements. The behaviour of the univalent chromosomes is of the *Triticum*-type. Detailed observations on embryological development are given for *A. strigosa*, *A. fatua*, and their reciprocal crosses taken at periods of 24, 48, and 72 hours after pollination and illustrated by twenty-two text-figures. The difference of seed production in reciprocals is discussed at length from two standpoints : (1) pollen-tube growth, and (2) the activating stimulus of the male nuclei.   J. S.

Anatomy and Morphology.

Wood Structure of Gleasonia duidana.—S. J. Record (" The Wood of *Gleasonia duidana*," *Trop. Woods*, 1932, **32**, 18–20). The general characters and anatomical structure of the wood of *Gleasonia duidana* Standley, a recently described genus and species of the Rubiaceæ, are described from the type specimen. The wood weighs about 57 lb. per cubic foot in the air-dry condition and has a rather fine, uniform texture. Growth rings are poorly defined by narrow zones

with few pores. The pores are mostly single, irregularly disposed without definite pattern, average diameter 98μ. Vessel perforations are simple. Wood parenchyma is sparingly developed, being limited to a few cells in contact with some of the pores and a narrow terminal line. Rays are heterogeneous up to 25 cells high, with most of the cells upright, often in palisade, uniseriate except for procumbent portions which may be biseriate. The parenchyma-vessel pitting is often unilaterally compound, more or less scalariform, a simple pit of a ray or wood parenchyma cell subtending two to five bordered pits of the vessel. Fibretracheids compose the ground mass of the wood; they have a fairly definite radial arrangement; pits are numerous in both radial and tangential walls, bordered with vertical, narrow lenticular apertures.   B. J. R.

Wood Structure of Schizocardia and Related Genera.—S. J. RECORD (" Woods of the Ericales, with Particular Reference to *Schizocardia*," *Trop. Woods*, 1932, **32**, 11–14). The new genus and species *Schizocardia belizensis* Smith & Standley having been referred to the family Clethraceæ, a comparative examination of the woods was undertaken. A study of the woody characteristics of the Ericales indicates that this order is a fairly homogeneous group without sharp division into families along the lines proposed by taxonomists, except probably in the case of the Epacridaceæ. Generic and specific differences are often pronounced. There is strong indication of relationship between the Ericales and the Theaceæ. The wood of *Schizocardia* is in general conformity with the order, but the data available do not indicate a close relationship with *Clethra*. The most noticeable structural differences are as follows : in *Clethra* the vessel members and the fibres are about twice as long, the perforation plates are much more steeply inclined, and the number of bars is from three to ten times as many as in *Schizocardia*. These distinctions are of a fundamental character and indicate that *Clethra* is more primitive than *Schizocardia*.   B. J. R.

Identification of Eucalyptus Woods.—H. E. DADSWELL and M. BURNELL (" Methods for the Identification of the Coloured Woods of the Genus *Eucalyptus*," Comm. of Australia, *Council for Sci. and Ind. Research, Bull. No.* 67 (*Div. of For. Products, Tech. Paper No.* 5), 1932, 50 pp., 34 pls., 10 figs.). A comprehensive investigation of thirty-seven species of *Eucalyptus* woods based on a study of at least ten authentic specimens of each. Macroscopic examination covered the description of the colour of the wood, its fissility, grain and general characteristics, the burning splinter test, and the determination of the size of the pores and their number over a definite area. Microscopic examination included the preparation of transverse, radial and tangential sections from each specimen and the examination of the pores, rays, and parenchyma cells. The results are tabulated and a tentative key to the identification of the species is given. Photomicrographs illustrating the typical appearance of transverse and tangential sections are included.   B. J. R.

Identification of Canadian Woods.—J. D. HALE (" The Identification of Woods commonly used in Canada," *Forest Service Bull. No.* 81, Dept. of Interior, Canada. Ottawa, 1932, 48 pp., 14 pls.). The subject is introduced by a section describing the characters useful in the identification of woods. This is followed by a lens key to the identification of commercial groups of timbers. Besides native Canadian woods a few imported woods such as the various mahoganies are included. The key is supplemented by descriptions of the woods and by illustrations which are mostly photographs of actual wood surfaces as seen under a lens.
                                            B. J. R.

Anatomical Structure of Indian Timbers.—R. S. PEARSON and H. P. BROWN ("Commercial Timbers of India," Govt. of India Central Pubn. Branch, Calcutta, 1932, vol. 1, xliv + 548, vol. 2, ix + 549–1150, 320 pls.). A comprehensive account of 320 of the most important commercial species of India, comprising information under the headings, distribution, supplies, anatomical structure, physical and mechanical properties and uses. The anatomical structure of the woods is described in great detail, the description of each species being illustrated by two photomicrographs of cross-sections at magnifications of 10 and 110 respectively. There are two appendices, giving a classification of the timbers according to uses and a glossary of scientific and technical terms used in the text; also a full bibliography.   B. J. R.

Identification of Indian Sleeper Woods.—K. A. CHOWDHURY (*Forest Bull. No. 77, Economy Series.* Calcutta, Government of India Central Publication Branch, 1932, 18 pp., 31 pls., 1 map). The introduction briefly describes the anatomical structure and general physical features of wood in such a way as to explain the terms used in the key. The key itself is based on macroscopic structural features visible with a hand lens. It is supplemented by a series of photomicrographs of cross-sections at a magnification of ten diameters, and by a map showing the various species of sleeper woods likely to be met with in the areas with which the different railway groups are concerned.   B. J. R.

Fossil Dicotyledonous Woods from East Africa.—H. BANCROFT ("Some Fossil Dicotyledonous Woods from the Miocene (?) Beds of East Africa," *Ann. Bot.*, 1932, **46**, 745–68, 1 pl., 4 figs.). Four fossil woods from what are probably Miocene beds of Kikongo, Kenya Colony, are described and figured. In the absence of any associated vegetative and reproductive remains to indicate their affinities, the specimens are referred to Schleiden's form genus *Dryoxylon* and compared with various recent and fossil timbers. The following specific references are proposed : (1) *D. symphonioides*, a wood of the *Ficus* type (*i.e.* with alternating zones of fibres and parenchyma) showing considerable similarity of structure to that of *Symphonia* spp. (2) *D. bombacoides*, compared with various Malvalean woods, particularly *Bombax Ceiba*. (3) *D. kenyense*, a wood of generalized type such as occurs in many living genera and families, e.g., in *Myrica, Cornus, Rhododendron, Viburnum*, etc., and which is also found amongst the earliest woods so far known, e.g., in the Cretaceous forms *Aptiana radiata* and *Cornoxylon myricæforme*. (4) *D. drypeteoides*, compared with the wood of *Drypetes* sp.   B. J. R.

Classification of the Genus Pinus on the Anatomy of the Wood.—R. ROL ("Note sur un essai de classification du genre *Pinus* d'après des caractères tirés de l'anatomie du bois," *Report of 65th Congrès des Sociétés Savantes*, 1932, 333–41, 8 figs.). The classification is based primarily on the anatomy of the medullary rays. Four types of ray tracheid are recognized : (*a*) walls smooth, generally thin (*P. Strobus*), sometimes with local swellings of the middle lamella (*P. monticola*) ; (*b*) walls smooth but fairly thick and swollen at the edges of the bordered pits which thus protrude into the interior of the tracheids ; (*c*) walls variable in thickness with internal dentate thickenings, generally more numerous in the summerwood, fairly broad, not very acute (*P. sylvestris*) ; (*d*) walls generally thin, internal dentate thickenings extremely numerous, thin, acute and fused transversely, producing reticulate appearance (*P. Tæda*). Ray parenchyma cells vary in wall thickness and pitting especially on the radial walls. The walls may be (*a*) very thin and without visible pits ; (*b*) thick with simple pits of variable size and shape ; (*c*) very thick with numerous simple pits, small in size, well defined. The pits on

the radial walls of the ray parenchyma cells in the spring-wood zone are classified under four types : (a) a single pit, subrectangular or oval, rarely divided into two or three (P. sylvestris) ; (b) one to three pits, the opening into the parenchyma cell rounded, that into the tracheid elongate-oval, somewhat resembling a bordered pit, medium size or small ; (c) one to four pits, oval or elliptical, more or less irregular, generally fairly small (P. ponderosa) , (d) three to six pits, irregular in shape and variable in size, rather large (P. Tœda). Forms intermediate between (c) and (d) occur. The maximum ray height, expressed as the number of cells, is probably a feature of specific diagnostic value, but to make use of this it is essential to examine wood from the trunk of a mature tree. The pits on the tangential walls of the summer-wood tracheids constitute a character of diagnostic value. In the following classification, the species investigated are divided into sections whose names correspond to Mayr's classification : (1) Ray tracheids with smooth walls, not numerous ; ray parenchyma pits usually with a single large subrectangular pit to each cross-field, more rarely two or three ; ray parenchyma cells with thick or thin walls. Numerous pits on the tangential walls of the last rows of summer-wood tracheids.—Section Strobus. (2) Ray tracheids with smooth walls, not numerous ; ray parenchyma cells with two to four pseudo-bordered, round or oval pits ; the small walls of the ray parenchyma cells thick or very thick. Pits on tangential walls of summer-wood tracheids usually numerous.—Section Parrya. (3) Ray tracheids with sinuous walls, inconspicuously dentate, especially in summer wood ; ray parenchyma cells with one to four pseudo-bordered pits, round or oval, moderate-sized ; walls of ray parenchyma cells thick to very thick ; pits on tangential walls of summer-wood tracheids absent.—Section Sula. (4) Ray tracheids fairly numerous, with dentate thickenings, variable in number, generally more numerous in summer wood ; ray parenchyma cells with one to four oval or fusiform pits, often irregular and uneven ; fairly small ; ray parenchyma cell walls predominantly thin. Rays not very high. Pits on tangential walls of summer-wood tracheids absent.—Section Ponderosa. (5) Ray tracheids very numerous, with acutely dentate thickenings, often very numerous and fused to produce reticulate appearance ; numerous ray tracheids in the body of the ray. Ray parenchyma cells with three to six pits, variable in size and irregular in shape, fairly large, the cell walls very thin or rarely slightly thickened. Pits on the tangential walls of the summer-wood tracheids rare and scattered.—Section Tæda. (6) Ray tracheids with sinuous walls, inconspicuously dentate, principally in the summer wood ; ray parenchyma cells with one, sometimes two large, subrectangular pits, the cell walls generally thin. Pits on tangential walls of summer-wood tracheids absent.—Section Khasya. (7) Ray tracheids with well-defined dentate thickenings ; some tracheids in the body of the ray ; ray parenchyma cells with one, rarely two large,subrectangular pits, the cell walls generally slightly thickened, sometimes thin. Pits on the tangential walls of the summer wood rarely present.—Section Sylvestris. The sections delimited above can in certain cases probably be subdivided on supplementary characters. The Strobus section, for instance, is probably divisible into subsections Cembra and Eu-strobus on the characters of the radial resin ducts in fresh material. The Ponderosa section also could probably be subdivided after further investigation.   B. J. R.

The Differentiation and Seasonal Variation of the Phloem in Ash.— N. GILL (" The Phloem of Ash (Fraxinus excelsior Linn.)—its Differentiation and Seasonal Variation," Proc. Leeds Phil. and Lit. Soc., 1932, **2**, 347–55, 1 pl., 6 figs.). The material for this investigation, consisting chiefly of one- and two-year-old twigs, was collected from a tree about 20 feet high growing near the centre of

Leeds. Samples were collected at intervals varying from a week in spring to a month in winter, over a period extending from the end of April, 1930, to the beginning of December, 1931. The production of phloem commences in spring as the terminal bud begins to swell. Differentiation is slow at first until the leaves are fully expanded; afterwards vigorous phloem production proceeds until shortly before leaf-fall. The sieve-tubes formed in spring and summer are described together with their method of differentiation. Three or four weeks before leaf-fall a modified form of phloem is differentiated. No phloem is produced after leaf-fall. In spring the autumn phloem rapidly becomes crushed by the newly differentiating summer phloem. Phloem differentiation in the petioles, terminal bud, and bud-scales is described. B. J. R.

Fibres used in Paper Making.—C. H. CARPENTER (" An Atlas of Paper-making Fibres," *Bull. New York State Coll. Forestry*, 1931, 4 (3 b), *Tech. Pub.* 35, 7 pp. 56 pls.). Photomicrographs at magnifications of 90 and 180 of the chief fibres used in paper-making in the United States. Twenty-six are from coniferous trees (softwoods), seventeen from broad-leaved trees (hardwoods), and the remainder from maize, sugar-cane, oat, bamboo, esparto grass, cotton, flax, hemp, Manila hemp, Mauritius hemp, Sisal hemp, and jute. B. J. R.

Medullary Bundle System in the Ranunculaceæ.—M. KUMAZWA (" The Medullary Bundle System of the Ranunculaceæ and Allied Plants," *Bot. Mag. Tokyo*, 1932, 46, 327–32. In Japanese. English summary, *ibid.*, 260–1, 1 fig.). Medullary bundles occur in the äerial stems of the following genera and species : *Thalictrum* spp., *Anemone japonica, A. vitifolia, A. rivularis, Ranunculus chinensis, Cimicifuga, Anemopsis, Glaucidium, Hydrastis, Podophyllum,* and *Diphylleia.* The medullary bundles are of five types which vary in their course and origin : (1) Leaf-trace strands which pass directly into the pith at a node. Strands from the perianth do not enter the pith. (2) As (1), but perianth-traces also enter the pith. (3) Leaf-trace strands descend through the first internode in the ordinary circle of bundles and enter the pith in the second internode. (4) Strands from the perianth occupy the central part of the pith throughout the stem. (5) The relatively large bundles from the lateral shoots pass through the pith. The possible lines along which these different types may have been evolved are discussed. C. R. M.

Anatomy of Medicago sativa.—CLARA WOLFANGER WINTER (" Vascular System of Young Plants of *Medicago sativa*," *Bot. Gaz.*, 1932, 94, 152–67, 34 figs.). The primary vascular system in the roots of *Medicago sativa* L. is usually triarch, but less frequently tetrarch. Plants having triarch roots are nevertheless tetrarch in structure in the region of the hypocotyl. The primary system of the root, hypocotyl, and cotyledons forms a complete circulatory system of its own, independent of subsequent plumular development. It recapitulates the phases of evolutionary development as described by Chauveaud (*Ann. Sci. Nat. Bot.*, Sér. 9, 13, 113–438) in his phanerogamic cycle. The plumular elements are collateral and endarch. The traces to the first and second leaves are the first plumular vessels. Secondary tissues at an early stage form a continuous conducting system through root and shoot. Other features of the vascular anatomy of young plants are described in detail. C. R. M.

Anatomy of Asparagus officinalis.—CHARLES H. BLASBERG (" Phases of the Anatomy of *Asparagus officinalis*," *Bot. Gaz.*, 1932, 94, 206–14, 10 figs.). An account of the development of the seedling, and of the structure of the root and

stem of *Asparagus officinalis*. The storage roots grow in thickness to a consider-able extent as a result of cell divisions in the cortex. An inulin-like substance asparagose is present in most of the cells of the cortex of the storage roots. A saponin is also present. Fructose is present in actively growing plants, but when the plant becomes dormant the fructose content decreases and the sucrose content increases. Oil is present in all parts of the plant. Starch is not stored in any quantity.   C. R. M.

Anatomy of Fouquiera splendens.—FLORA MURRAY SCOTT (" Some Features of the Anatomy of *Fouquiera splendens*," *Amer. J. Bot.*, 1932, **19**, 673–8, 7 figs.). The anatomy of *Fouquiera splendens*, the Ocotillo or candle bush, is typical of that of the Dicotyledons in general, but it has certain unusual features. The surface of the stem is covered with reticulations of smooth and ragged cork, the smooth cork consisting only of fibrous cork cells, whilst the ragged portions are composed of alternating bands of suberized non-fibrous cells and fibrous cells respectively. The cork cambium arises in the outer cortex when the shoots are still very young. Most of the cortex is composed of a band of photosynthetic cells, but includes collenchyma, stone cells, and water-storage cells as well. The water-storage cells form a continuous network which follows the line of distribution of the ragged cork. The structure of the stele in the stem is briefly described, as is also the root structure, but neither shows any unusual features. The network of water-storage cells is thought to be of importance in facilitating the exceedingly rapid production of leaves following an increase in the available water supply.
                                                                        C. R. M.

Structure of some Cretaceous Plants from Hokkaido.—YUDZURU OGURA (" On the Structure and Affinities of some Cretaceous Plants from Hokkaido. Second Contribution," *J. Fac. Sci. Imp. Univ. Tokyo*, 1932, **2**, 455–84, 16 figs., 3 pls.). The following material is described : *Cycadangium compactum*, gen. et sp. nov.—A sporophyll with sunken stomata bearing a group of Cycadean sporangia. Sporangia cylindrical, crowded. Sporangial wall consisting of an outer layer of thick-walled and an inner layer of thin-walled cells. *Stachycarpites projectus*, gen. et sp. nov.—A small coniferous seed, with a thick fleshy integument consisting of three layers ; a ring of small vascular bundles is present in the middle layer of the integument. Thought to have affinities with *Podocarpus* and *Stachycarpus*. *Piceophyllum simplex*, gen. et sp. nov.—A needle, having affinities with the Abietineæ ; elliptic in cross-section, with two shallow stomatal grooves on the lower side. Epidermis and hypodermis consist of thick-walled cells ; mesophyll thin-walled. One small vascular bundle in the centre. *Pinus flabellifolia* sp. nov. —A leaf of a three-needled pine. Epidermis thick-walled, interrupted by sunken stomata, hypoderm thick-walled. One layer of mesophyll with indistinct internal projections from the cell walls. Two resin canals present at the corners of the cross-section. Endodermis well defined. *Pinus pseudostrobifolia* sp. nov.—Leaf fascicle of five-leaved pine, with short shoot in centre and scales in periphery. *Sciadopitys cretacea*—A needle of *Sciadopitys*, elliptical in cross-section, with a deep median groove on the lower side, stomata present only in the groove. Epidermis and hypodermis sclerenchymatous, each consisting of one layer. Mesophyll of palisade cells at the periphery surrounding spongy parenchyma. At least two pairs of resin canals present. *Yubaria inuaginata* gen. et sp. nov.—A Dicotyledonous petiole. Hypodermis thick, composed of sclerenchyma. About fifty to sixty collateral vascular bundles, mainly composed of secondary tissue enclosed by sclerenchyma. Affinities uncertain.   C. R. M.

Structure of a Famous Silicified Trunk.—YUDZURA OGURA ("On the Structure of 'Hobashira-ishi,' a Famous Silicified Trunk at Najima near Fukuoka City," *Jap. J. Bot.*, 1932, 6, 173–81, 4 figs., 1 pl.). An account of the structure of a silicified trunk of tertiary origin. This is best summarized by repeating the following diagnosis verbatim : "*Quercinium hobashiraishi* sp. nov. Angiospermous wood related to *Quercus*. Annual rings distinct, but not very prominent. Vessels generally diffuse, with tendency to be radial; large in spring wood, gradually diminishing towards autumn wood ; solitary, seven to twelve per sq. mm. ; elliptic in cross-section, large ones 230–270μ × 250–350μ, small ones 60–100μ × 80–120μ in diameter; lateral wall with rows of small bordered pits ; prominent tyloses within. Tracheids and parenchyma metatracheal and tangential, abundant in spring wood, scarce in autumn wood ; lateral wall of tracheids with one or two rows of small bordered pits ; intermediate forms between tracheidal and parenchymatous cells abundant. Thick-walled wood-fibres abundant, especially in autumn wood. Medullary rays either uniseriate or broad ; uniseriate ones abundant, 14–16 in the breadth of 1 mm., 3–20 cells, mostly 10–16, in height ; lateral wall with small pits ; wall between vessels with rows of lens-shaped pits ; broad rays rare, up to 300μ in breadth, compound, including a few other elements."

<div align="right">C. R. M.</div>

Structure of Silicified Wood.—YUDZURU OGURA ("On the Structure of a Silicified Wood near 'Hobashira-Ishi' at Najima near Fukuoka City," *Jap. J. Bot.*, 1932, 6, 183–90, 4 figs, 1 pl.). An account of *Phyllanthus pseudo-hobashiraishi* gen. et sp. nov., a silicified wood found near the one described in the last abstract. The diagnosis given is as follows : Dicotyledonous wood with affinity to Euphorbiaceæ. Annual rings present, but usually not clear. Vessels diffuse, with a tendency to a radial arrangement owing to medullary rays ; solitary, or two to four grouped in a radial direction ; 13–16 vessel groups or 23–40 vessels per sq. mm., solitary vessels oval in cross-section, 100–200μ × 70–140μ in diameter ; individual vessels composing the groups oval in cross-section ; vessels in close contact ; wall with closely arranged oval or angular bordered pits when in contact with each other ; and with roughly (irregularly ?) arranged oval simple pits when in contact with parenchyma or medullary rays. Fibres constitute the groundwork of the wood ; typical long fusiform, angular in cross-section ; variable in size, 15–25μ in diameter ; irregular in arrangement ; membrane thin, 3–4μ, with small pits. Parenchyma cells very few ; paratracheal, thin-walled, showing the nature of septate fibres. Medullary rays heterogeneous, in two forms, uniseriate rays, rare in occurrence, 3–8 cells high, consisting of radial cells flanked by 1–2 rows of erect cells, wall thin with small pits.

<div align="right">C. R. M.</div>

Seedling Anatomy of Ipomœa batatas.—HERMAN E. HAYWARD ("The Seedling Anatomy of *Ipomœa batatas*," *Bot. Gaz.*, 1932, 94, 400–20, 12 figs, 2 pls.). The tough seed coat of *Ipomœa batatas* Lam. is impervious to water, and the internal structure of the seed is similar to that already described for other species of *Ipomœa* and for *Convolvulus*. The primary root is tetrarch. The stele and cortex are developed from a well-defined plerome and periblem respectively, whilst the calyptrogen gives rise to the root cap and epidermis. The four groups of primary phloem are the first parts of the vascular portion of the stele to develop, whilst four primary latex vessels abutting on the pericycle are formed from a single vertical row of phloem cells in each group. The primary xylem differentiates centripetally. Lateral roots (which are usually tetrarch, but may be triarch) begin to arise even before the protoxylem is completely differentiated. Details of the

transition structure in the hypocotyl are given. The internal arises after the external phloem. There are no regular connections between the internal and external phloems, although anastomoses were observed in the petioles of the cotyledons, where they were formed by the differentiation of the intervening parenchyma cells. " The late appearance of the internal phloem at a time when the seedling is beginning to function photosynthetically suggests a correlation between the function of the phloem and its anatomical development."

<div align="right">C. R. M.</div>

Morphology and Anatomy of Kleinia articulata Haw.—D. THODAY and N. WOODHEAD (" Studies in Growth and Differentiation. II. A Preliminary Survey of the Morphology and Anatomy of *Kleinia articulata* Haw.," *Ann. Bot.*, 1932, **46**, 671–82, 4 figs., 1 pl.). A general account of the anatomy of *Kleinia articulata* Haw. " The outstanding features of the anatomy of the ordinary mature aerial stems are the large colourless pith, the green cortex, the small vascular bundles, the poverty in mechanical tissue, and the thinness of the walls of the parenchyma generally." The structure of the rhizome varies with the diameter. Where the diameter is large the structure in transverse section is very similar to that of the aerial stem, but with the vascular structure more strongly developed. In thin rhizomes there is a continuous ring of xylem. The tissues at the articulations between branches and parent stems are strongly lignified. A Casparian strip is present in aerial stems between the phloem of the principal bundles and the resin canal which invariably accompanies them. In some rhizomes and in etiolated stems there is a complete Casparian strip. Calcium oxalate occurs in the collenchyma beneath the epidermis or periderm of the aerial stem, and in association with strongly lignified tissues such as those at the articulations of the branches and near the woody zone of slender rhizomes. The length of the stem-joints varies greatly according to the cultural conditions.   C. R. M.

Anatomical Evidence concerning the Relationship of the Alismataceæ to the Ranales.—FRITZ JÜRGEN MEYER (" Die Verwandschaftbeziehungen der Alismataceen zu den Ranales im Lichte der Anatomie," *Bot. Jahrb.*, 1932, **65**, 52–9). The anatomical evidence supports Engler's opinion that there are considerable differences between the Ranales and the Alismataceæ. The most important features which indicate that these two groups are not closely related to one another are : (1) Differences in the arrangement of the stomata. Subsidiary cells are present in the Alismataceæ but absent from the Ranales. (2) The hairs of the Alismataceæ are in fascicles, whereas those of the Ranunculaceæ are either simple adpressed or glandular hairs. (3) The occurrence of characteristic internal secretory organs in the Alismataceæ which are absent from the Ranales. Some features of the structure of the vascular bundles are similar in the two groups whilst others are not. The two groups also agree in having apical hydathodes, which arise in the same way. The author considers that the similarity of the epidermal cells, the occurrence of absorbing cells (Hydropoten), and similarities in the mesophyll and its component cells in both groups are unimportant features in deciding whether or not the Ranales and the Alismataceæ are closely related.

<div align="right">C. R. M.</div>

Vascular Anatomy of the Flowers of Silene maritima.—C. A. PRATT (" Researches on *Silene maritima* and *S. vulgaris* X. Investigation of the Vascular Anatomy of the Flowers of *Silene maritima*," *Kew Bull.*, 1932, 390–4, 11 figs.). Flowers of *Silene maritima* were examined anatomically " in order to substantiate, if possible, the suggestion put forward by R. O. Whyte (*Nature*, CXXIII, 113'

1929, and *Journ. Genetics*, XXIII, 109, 1930) that the sexual and petal differences exhibited might be due to, or at least correlated with, variations in the vascular anatomy of the flowers.—All the evidence obtained points to the conclusion that the failure of certain flowers of *Silene maritima* to complete development of anthers and petals cannot be ascribed to any anatomical defects of the vascular bundles."

<div align="right">C. R. M.</div>

Flower Bud Differentiation in Gladiolus.—JOHN V. WATKINS ("Flower-bud Differentiation in the *Gladiolus*," *Proc. Amer. Soc. Hort. Sci.*, 1931, 28, 407–9, 2 pls.). "The author undertook to establish, through a histological study of the growing points of flowering-size corms, the time in the life-cycle of the *Gladiolus* that flower buds are formed. . . . The histological studies of the *Gladiolus* buds reveal that flower spikes are formed after growth has started during the current growing season."

<div align="right">C. R. M.</div>

Multiple Male Cells in Cupressus arizonica.—CLIFTON C. DOAK ("Multiple Male Cells in *Cupressus arizonica*," *Bot. Gaz.*, 1932, 94, 168–82, 17 figs.). This paper deals with the ontogeny of the male gametophyte of *Cupressus arizonica*. It is shown that there is great irregularity in pollen-tube behaviour and in the time of its development. Evidence is cited to support the view that two equal, functional male cells may occasionally occur. A pollen-tube develops a complex of several male cells in most cases and occasionally these are differentiated into "sperm cells" with distinctive shapes, suggesting possible motility. Blepharo-plasts were not seen and the evidences for cilia were not conclusive, but it is suggested that ciliated sperms may possibly be found among the higher conifers. The complete return to ciliated sperms as a regular habit is not regarded as likely, but may occur as representing the extreme of an atavistic tendency. Evidence is given to support the view that the many male cells of a single pollen-tube serve to fertilize a number of different ova in a number of separate archegonia of the complex. The male-cell complex is considered to be a reversion. When the development of an archegonial complex made possible multiple fertilizations from a single pollen-tube, the trend towards reduction was reversed.

<div align="right">F. B.</div>

Seed Development in Pinus palustris.—A. C. MATHEWS ("The Seed Development in *Pinus palustris*," *J. Elisha Mitchell Sci. Soc.*, 1932, 48, 101–18, 6 pls.). An account of the development of the staminate cone, male gametophyte, ovulate cone, archegonia, and of fertilization and development of the embryos in *Pinus palustris*. In general, these processes resemble those previously described for other species of *Pinus*. However, deviations were observed, some of which are as follows: The microsporangial wall consists of four or five layers of cells, the tapetum being regarded as a layer apart from the wall. The microspores are liberated from the microspore-mother-cell after the wall of the latter has been digested. The cellular female gametophyte is enclosed by a megaspore membrane which persists even after embryos have been formed. The thick wall of the archegonium is pitted. The pollen tube normally penetrates the female gameto-phyte through a long closed channel above the neck of the archegonium. How-ever, it sometimes happens that the pollen tube digests the tissues of the female gametophyte and so gains access to the egg. The archegonial neck is composed of a tier of four pyramidal cells. The paper ends with a concise comparative account of the structure and development of the gametophytes and embryos of the Abietineæ.

<div align="right">C. R. M.</div>

Embryo Development in Kochia Scoparia (L.) Roth.—MARION E. WILLIAMS ("The Development of the Embryo of *Kochia Scoparia*," *Bull. Torrey*

Bot. Club, 1932, **59**, 391–400, 2 pl.). The campylotropous ovule of *Kochia Scoparia* possesses transparent integuments and the mature horseshoe-shaped embryo surrounds a region of perisperm. The eight-nucleate embryo-sac buried deeply in the nucellus is often seen with only the endosperm nucleus and the egg due to the early disappearance of the antipodals and the synergids and the fusion of the polar nuclei. The two upper tiers of the spherical embryo contribute to the plumule and cotyledons; the third, where the dermatogen is first cut off, contributes the hypocotyledonary region; the fourth, the plerome and periblem initials. The hypophysis produces two plates of cells; the upper one completes the dermatogen, the lower one furnishes the root-cap initials. Transverse divisions take place rapidly in the suspensor, which thereby becomes a long filament. The endosperm, at first free-nucleate, produces cells in the micropylar region which extend to the middle of the sac. Curvature of the embryo in the mature seed results eventually in the tip of the innermost cotyledon meeting the radicle. In the mature embryo the procambial strand forks at the cotyledonary node and passes to the tips of the cotyledons. As the procambium enters the cotyledon a branch turns off to supply the plumule.   F. B.

Embryology of Pecans and Walnuts.—D. V. SHUHART ("Endosperm and Embryo Development as Related to Filling of Pecans and Walnuts," *Proc. Amer. Soc. Hort. Sci.,* 1931, **28**, 161–3, 1 pl.). Previous workers have pointed out that a membrane exists in the spaces which are formed between the folds of the cotyledons in the centres of pecan kernels, and mentioned that the origin of this membrane was unknown. The author's investigation has confirmed the existence of such a membrane, and embryological studies have shown that it represents the dead, undigested remains of the endosperm. Removing leaves from the shoots after the embryo was approximately one-third to one-half full grown did not prevent the embryo from enlarging.   C. R. M.

Embryology of Cyperaceæ and Gramineæ.—MARGARETE SCHNEIDER ("Untersuchungen über die Embryobildung und -entwicklung der Cyperaceen mit Berücksichtigung angrenzender Fragen wie Vergleich der Embryobildung und -entwicklung von Cyperaceen und Gräsern, Keimung bei den Cyperaceen, Rolle des Saugorgans der Cyperaceen bei der Keimung," *Beih. bot. Centralb.,* 1932, **49**, 649–74, 42 figs.). Embryos of the *Cyperus* and *Scirpus* types are remarkable for being orientated in the seed in the inverse position to that which is normal in most plants. However, the embryos at a very early stage were found to be orientated in the normal way, so that, in reality, the abnormal position is assumed during their development. The endosperm takes no part in these changes. A comparison of the embryology of the Cyperaceæ with that of the Gramineæ shows that the early stages are very similar in both families; in the later stages development proceeds along different lines. Germination in the Cyperaceæ occurs in the same way in all the species examined. Details of this process are given. The starch of the endosperm of the Cyperaceæ, in the same way as that in the Gramineæ, is acted upon by amylase.   C. R. M.

Post-floral Nectar-secretion in Jasminum nudiflorum Lindl.—ERICH DAUMANN ("Über postflorale Nectarabscheidung zugleich ein weiterer Beitrag zu unseren Kentnissen über ungëwohnlichen Blümenbesuch der Honigbiene," *Beih. bot. Centralb.,* 1932, **49**, 720–34, 3 figs.). The floral nectary of *Jasminum nudiflorum* Lindl. is developed on the surface of the free portion of the ovary. In spite of the presence of nectar-secreting pores, only a small proportion of the secretion takes place actually through these. Most of the sugar-containing fluid passes out through

the thin epidermis and cuticle without the latter being damaged. Cavities are present in the epidermis of the nectary which is free from the overlying cuticle. The secretion of nectar continues for 3–8 days after the corolla has fallen. Details of the mode of pollination by the honey-bee (*Apis mellifera* L.) are given.

<div align="right">C. R. M.</div>

Cork-like Substances in the Floral Nectaries of Brownea. — ERICH DAUMANN (" Über körkartige Substanzen im Blütennektarium von *Brownea* (Hermesias). Beitrage zur Kenntnis der Nektarien 3," *Beih. bot. Centralb.*, 1932, **49**, 710–19, 10 figs.). A description of the nectar-secreting tissue which develops within the cup-shaped receptacle of *Brownea ariza* Benth. In spite of the presence of nectar-secreting pores, fluid nectar is secreted chiefly through the outer walls of the epidermis of the nectary, the fluid passing directly through the cuticle. This cuticle gives the same chemical reactions as does the cuticle from other plant parts, but, nevertheless, during secretion aqueous solutions pass through it more readily than through cuticle from other plant parts. The nectary is surrounded by cellulose tissue in which yellow-brown portions can be recognized when secretion begins. A cork-like substance is formed in these as secretion proceeds, and the corky areas expand so that the nectary is surrounded by an almost complete covering of corky parenchyma cells. Just before secretion ceases a similar corky substance is deposited in the cells of the nectary itself. The chemical nature of the cork-like substance recalls that of the absorbing cells (Hydropoten) of water plants as well as that occurring in the floral nectaries of a species of *Nepenthes*. The flow of nectar is not appreciably restricted by the deposition of this cork-like substance.

<div align="right">C. R. M.</div>

Microchemical Studies of Ginkgo biloba.—RUTH SCHOLZ (" Micro-chemical Studies of the Changes during Vernal Activity in *Ginkgo biloba*," *J. Elisha Mitchell Sci. Soc.*, 1932, **48**, 133–7). An account of an investigation carried out in order to determine whether the food materials stored in *Ginkgo biloba* are similar to those in other deciduous trees or if " they are distinctive of the Gymnosperm group." Microchemical tests, the nature of which is indicated, were checked with macrochemical ones. The main conclusions were that resin ducts, formed lysigenously in the " primordia of the leaf buds," serve for the storage of fatty oils, resins, and free benzoic acid. Starch, formed as the first product of photosynthesis, is not stored but converted to glucose and amino acids. Tyrosine is the chief storage product.

<div align="right">C. R. M.</div>

Systematic Importance of Spodograms of the Leaves of the Bambusaceæ.—KIICHI OHKI (" On the Systematic Importance of Spodograms in the Leaves of the Japanese Bambusaceæ," *J. Fac. Sci. Imp. Univ. Tokyo*, 1932, **4**, 1–130, 43 figs.). The author has attempted to facilitate the identification of the Japanese Bambusaceæ by the use of spodograms of their leaves. The method used, which consists of partially incinerating small portions of the leaves so that the microscopical details of the epidermis is retained in the ash, is a modification of that described by Werner (Blatt-Aschenbilder heimischer Wiesengräser als Mittel ihrer Verwandschafts- und Wertbestimmung, *Biologia Generalis*, 1928, **4**, 403–446). An analytical key to the genera is given, in which spodograms are taken as the principal criteria. Descriptions of the spodograms of the different species are also given. The author claims to have found microscopic features which distinguish species from one another in cases where macroscopic observation fails to do so. The material studied was obtained chiefly from the herbarium of the Botanical Institute at the Imperial University of Tokyo. Material from the botanic gardens at Koishikawa and Nikko was also used.

<div align="right">C. R. M.</div>

Structure and Physiological Significance of Two Kinds of Glands in Insectivorous Plants.—M. KRUCK and H. ZIEGENSPECK (" Die zwei vorhanden Drüsenarten der Insektivoren und ihre physiologische Bedeutung," *Bot. Archiv.*, 1932, **34**, 363–93, 14 figs. English Summary). The cuticles of the digestive glands of *Cephalotus, Nepenthes, Aldrovandia, Drosera, Dionœa*, and *Pinguicula* are perforated by pores of various sizes. All substances which enter the cytoplasm gain access to it through these pores. The cuticle usually consists of cutin, but sometimes of endodermin (which dissolves in CrO_3 but not in H_2SO_4). The latter substance is more permeable to water than is cork. Specialized digestive glands are absent from the Sarraceniaceæ. The nuclei of the glandular cells are provided with abundant nucleoli. Hydathodes, similar in structure to the digestive glands, are present in *Sarracenia, Darlingtonia, Cephalotus, Nepenthes, Aldrovandia, Drosera, Pinguicula*, and *Dionœa*.   C. R. M.

The Traps of Utricularia and Polypompholyx.—FRANCIS E. LLOYD (" The Range of Structural and Functional Variety in the Traps of *Utricularia* and *Polypompholyx*," *Flora*, 1932, **26**, 303–28, 16 figs.). This paper is the second part of a study of the morphology of the insectivorous bladder-traps of the genus *Utricularia*. Fifty species are described in this paper, including two species of the genus *Polypompholyx*. The technique adopted by the author in sectioning the traps for study is described. The total number of species is seventy-five (including *Polypompholyx*), which are found to be capable of arrangement into fifteen categories of types. A tendency towards dimorphism of the traps is seen in *U. resupinata, U. Welwitschii*, and *U. diploglossa*, whilst the condition is fixed in *U. Lloydii, U. albina, U. volubilis*, and *U. Hookeri*. The two kinds of traps differ in size and appearance, while in *U. Lloydii* they are associated with the leaf and stolon respectively. An interesting condition exists in *U. Hookeri, U. volubilis, U. dichotoma, U. monanthos, U. violacea*, and *U. Menziesii*, all from Australia and/or New Zealand. All possess traps provided with two pairs of membranous wing-like appendages. The tissue of the entrance also is prolonged into an elongated horn. A pronounced departure from the general type of door structure is seen. The snap action of the door is due to a transverse fold which gives way suddenly when crossed by the longitudinal buckling following the impact of a small animal. A circular velum is also present which renders the door watertight and enables it to resist a higher water pressure. Dimorphism of traps is strikingly shown in the genus *Polypompholyx*, their relative sizes being in the ratio of 3 : 1. The larger trap measures 4–5 mm. long. The differences between the two species, *P. multifida* and *P. tenella*, are not great. The traps are strongly anatropous with a complicated structure. It is shown that the trap entrance is very small relative to the size of the trap and much smaller than in *Utricularia*. The door has quite a different form from that in *Utricularia* and possesses no hinge mechanism. The most striking difference between the two kinds of traps lies in the trichomatous armature of the threshold. The mechanical conditions for trap action appear to be difficult, and the interpretation is suggested that here the door acts as a simple valve and is incapable of contributing to the sustension of a low pressure of water within the trap. The structure and behaviour of the trap thus harmonize with the general primitive character of the plant as a whole.   F. B.

CRYPTOGAMIA.

Pteridophyta.

Grammatopteris.—B. SAHNI (" On a Palæozoic Tree-fern, Grammatopteris Baldaufi (Beck) Hirmer, a Link between the Zygopterideæ and Osmundaceæ," *Ann. Bot.*, 1932, **46**, 863–77, 1 pl., 5 figs.). A reinvestigation of the type specimen of *Protothamnopteris Baldaufii* Beck, a silicified tree-fern from the Lower Permian at Chemnitz. Hirmer's transference of the fossil to the genus *Grammatopteris* is upheld. The affinity of this genus is not with Botryopterideæ, but with the Zygopterideæ and Osmundaceæ, and more with the former than with the latter family. Further, the mutual affinity of these two families is supported by the evidence afforded by the structure of *grammatopteris.*   A. G.

Fossil Ferns.—A. B. WALKOM (" Fossil Plants from Mount Piddington and Clarence Siding," *Proc. Linn. Soc. New South Wales*, 1932, **57**, 123–6, 1 pl., 1 fig.). Descriptions of some fragments of fossil ferns from the Hawkesbury Sandstone of Mount Piddington, and of a new genus and species—*Rienitsia spathulata*—from the Hawkesbury Sandstone at Clarence Siding; in this the long pinnæ retain evidence of the venation and of the sori of the sporangia, but the presence of an annulus is as yet indeterminate; and the affinity of the plant is not clear.
                                                                        A. G.

Fossil Cyatheoid.—H. BANCROFT (" A Fossil Cyatheoid Stem from Mount Elgon, East Africa," *New Phyt.*, 1932, **31**, 241–53, 2 pls., 2 figs.). A description of a fossil tree fern from the volcanic series of Mount Elgon, East Africa. The stem structure agrees with that of recent Cyatheaceæ, but no reproductive fronds have been found. The structure does not agree with that of any known fossil genus. The form-genus name *Dendropteridium* is proposed for the reception of fossil tree-fern stems which cannot be definitely referred to already described genera; and the Mount Elgon stem receives the name *Dendropteridium cyatheoides* to indicate that it is a tree-fern stem with structure like that of Cyatheaceæ.
                                                                        A. G.

Cyathea.—H. GODWIN (" Anatomy of the Stele of *Cyathea medullaris* Sw.," *New Phyt.*, 1932, **31**, 254–64, 7 figs.). The vascular anatomy of the tree-ferns has hitherto been but little investigated. The present is a short illustrated account of the stelar anatomy of *Cyathea medullaris.*   A. G.

Bryophyta.

Bryophyte Plastid.—T. ELLIOT WEIER (" The Structure of the Bryophyte Plastid with reference to the Golgi Apparatus," *Amer. J. Bot.*, 1932, **19**, 659–72, 2 pls.). A careful comparison is made between the structure of the Golgi apparatus of various gland-cells with the bryophyte plastid, and of the appearance of the Golgi body and the plastid in relation to the amount of the secretion or starch present. The concept of the homology of the Golgi apparatus with the plant vacuole is reviewed in detail. The author inclines to the view that the homology is with the plastid and not with the plant vacuole; and he emphasizes certain points in favour of this theory.   A. G.

Plagiochasma.—ALEXANDER W. EVANS (" A New *Plagiochasma* from Texas," *Amer. J. Bot.*, 1932, **19**, 627–631, 7 figs.). Description of *Plagiochasma cuneatum*, a new species collected in Texas by McAllister in 1931. It is distinguished by the stomata, the ventral scale appendages, the spore structure, the articulate thallus.
                                                                        A. G.

Sphagnum Monstrosities.—I. GYÖRFFY (" Sphagnum-Monstruositäten aus der Hohen-Tàtra," *Revue Bryologique*, 1932, 4, 189–93, 1 pl.). The author describes and figures eleven instances of abnormal fruits of *Sphagnum*—twin capsules of equal or unequal size on one pseudopodium, asymmetric and hypertrophied capsules, and a case of acrosyncarpy reversed. A. G.

Post-glacial Mosses.—WILLIAM S. COOPER and HELEN FOOT (" Reconstruction of a Late-Pleistocene Biotic Community in Minneapolis, Minn.," *Ecology*, 1932, **13**, 63–72, 4 figs.). Excavations on the site of a new building in Minneapolis revealed abundant and well-preserved remains of plant and animal life of remote antiquity. Careful study of the organic remains in the sands and silts has provided a list of fragments of fifteen Mollusca and a beetle, four mosses, a *Chara*, five gymnosperms and three angiosperms. The most abundant were the moss fragments, representing two existing aquatic mosses—*Calliergon giganteum* and *Drepanocladus fluitans submersus*, and two extinct forms new to science—*Drepanocladus minnesotensis* and *Neocalliergon integrifolium*. The evidence shows that here was a lake in late Pleistocene time in the neighbourhood of a waning ice sheet, that sedimentation was going on in the water, and when the sedimentation was interrupted the mosses flourished. A. G.

Orthodontium.—P. ALLORGE and I. THÉRIOT (" *Orthodontium Gaumei* sp. nov.," *Revue Bryologique*, 1932, 4, 194–6, 1 pl.). Description and figures of a new moss found by R. Gaume on sandy rocks in the forest of Fontainebleau. Most species of *Orthodontium* belong to the tropics or subtropics. A. G.

Musci of Brotherus.—I. THÉRIOT (" Liste et correction des fautes orthographiques ou autres erreurs contenues dans la 2ᵉ édition des *Musci* de Brotherus, *in* Engler-Prantl, *Die natürlichen Pflanzenfamilien*," *Revue Bryologique*, 1932, 4, 170–85). A long list of corrections of orthographic slips and errors in the second edition of Brotherus's great work on the mosses in Engler's *Die natürlichen Pflanzenfamilien*. This is followed by an article " Sur les Règles de nomenclature botanique " (*op. cit.*, 186–88), containing pleas that pairs of authors should always maintain the same order of precedence, e.g., Broth. & Par., and never Par. & Broth.; and that the regulations as to terminal -i or -ii in specific names should be strictly observed, or even improved by the abolition of -ii. A. G.

American Mosses.—A. J. GROUT (" Moss Flora of North America North of Mexico," 1932, vol. iii, part 3. Published by the Author, Newfane, Vermont, pp. 115–78, plates 30–44). Part I of Vol. III contained three subfamilies of the Hypnaceæ; part 2 was concerned entirely with subfamily Amblystegieæ; and the present part comprises the subfamilies Hylocomieæ, Hypneæ, Stereophylleæ, Plagiothecieæ, and Entodonteæ, thus completing the study of the family Hypnaceæ. In the present part are descriptions of twenty-one genera and ninety-five species of Hypnaceæ. A few pages are also devoted to *Thuidium* (eleven species), a genus of the family Leskeaceæ. The habit, foliage, foliar morphology and cell-structure, fruit characters and inflorescence, of many of the species are illustrated in the plates. Keys to the genera and species are provided. A. G.

Australian Mosses.—ALAN BURGES (" Notes on the Mosses of New South Wales. I. Additional Records and Description of a New Species of *Buxbaumia*," *Proc. Linn. Soc. New South Wales*, 1932, **57**, 239–44, 1 fig.). In 1902 and 1905 Watts and Whitelegge published as Supplements to that periodical two parts of a projected " Census Muscorum Australiensium." The present author has collected

material for the completion of that Census, and in a series of papers will bring the records up to date. In the past, several records of undescribed species were published. A description of *Buxbaumia Colyerœ* is included ; this is a new species of an inconspicuous genus hitherto not found on the Australian continent. *Buxbaumia* is scattered sparsely over Europe and Asia ; a species was detected in Tasmania 80 years ago, and another species was found in New Zealand in recent years. Until the fruit is developed the plant, which grows on old logs, escapes notice. A. G.

Japanese Mosses.—H. N. DIXON ("Contributions to Japanese Bryology. Part I. Brachytheciaceæ," *Revue Bryologique*, 1932, 4, 153–69). A first contribution of determinations of Japanese mosses collected by Sasaoka, comprising fifty-four species belonging to ten genera of Brachytheciaceæ. The novelties described are a new genus, *Rigodiopsis* Dix. & Thér., twelve species, and a variety. A. G.

Japanese Mosses.—K. SAKURAI ("Beobachtungen über Japanische Moosflora," *Bot. Mag. Tokyo*, 1932, 46, 375–84, 496–509). Descriptions of thirty-four new species of mosses collected in south Kiusiu by Yoshio Doi. Some new varieties are described, and various species are recorded which were previously unknown to occur in Kiusiu. A. G.

Thallophyta.

Silicoflagellatæ.—GEORGES DEFLANDRE ("Sur la systématique des Silicoflagellés," *Bull. Soc. Bot. France*, 1932, 79, 494–506, 42 figs.). A discussion of four genera of Silicoflagellatæ—*Mesocena, Dictyocha, Distephanus, Cannopilus,* and the variability of the Endoskeleton. A. G.

Asiatic Algæ.—H. SKUJA ("Algæ " in " Botanische Ergebnisse der Deutschen Zentralasien-Expedition 1927–28," *Fedde's Repertorium*, 1932, 31, 4–19, 1 pl.). An account of the algæ collected in the Tibetan highlands by Emil Trinkler, Hellmut de Terra, and Walter Bosshard, comprising 53 Schizophyceæ, 113 Diatoms, 16 Chlorophyceæ ; six new species are described. The Zygnemataceæ are discussed by V. Czurda in a separate paper (*op. cit.*, pp. 19–23, 4 figs.), with descriptions of two new species. A. G.

Microflora of Rivers.—R. W. BUTCHER ("Studies in the Ecology of Rivers. II. The Microflora of Rivers with Special Reference to the Algæ on the River Bed," *Ann. Bot.*, 1932, 46, 813–61, 2 pls., 2 figs.). An account of the method adopted for determining the kinds and quantities of organisms which abound on river beds, and their seasonal variation ; of the relation of sessile algæ to potamoplankton ; a general consideration of the available data with reference to potamoplankton and its sources of supply, with numerous tables ; and a bibliography. A. G.

Anabænopsis.—WM. RANDOLPH TAYLOR ("Notes on the Genus *Anabænopsis*," *Amer. J. Bot.*, 1932, 19, 454–63, 2 pls.). A revision of the genus *Anabænopsis* of V. Miller. Certain of G. S. West's specimens of *Anabæna* from Lake Tanganyika were examined ; his *Anabæna flos-aquæ* var. *circularis* is divided into *Anabænopsis circularis* V. Miller, *A. Arnoldii* Aptek. forma, and *A. Cunningtonii* Taylor (a new species). Some Philippine material was also studied, and comprises a Philippine form of *A. Arnoldii*, and two new species—*A. philippinensis* and *A. luzonensis*, which are related to *A. Raciborskii* and *A. Elenkinii* respectively. A key to the species is provided. A. G.

Symbiotic Microspora.—PIERRE DANGEARD (" Sur un *Microspora* symbiotique d'une éponge, *Ficulina ficus* (*M. Ficulinæ* sp. nov.)," *Bull. Soc. Bot. France*, 1932, **79**, 491–4, 1 fig.). Description of an alga which grows symbiotically in the cortical tissue of a sponge, *Ficulina*, in some quantity on the coast of Penpoull in the west of France. The alga appears to be a marine species of *Microspora* and receives the name *M. Ficulinæ*.   A. G.

Vaucheria.—JOHN N. COUCH (" Gametogenesis in Vaucheria," *Bot. Gaz.*, 1932, **94**, 272–96, 35 figs.). A survey of the literature on sexual reproduction in *Vaucheria* is given from the time of Vaucher (1803) to the present, from which it appears that the sperms have been observed in all species. In *V. sessilis, V. pachyderma, V. aversa*, the development of the sperms and their discharge have been observed; in *V. geminata* the movement of the sperms in the antheridium has been observed. Discharge usually occurred at night. In *V. sessilis* the " Wanderplasm " initiates the formation of the oogonial branch, and migrates back into the main branch as soon as the oogonium reaches maturity. In *V. geminata* the " Wanderplasm " in retiring out of the oogonium carries with it most of the supernumerary nuclei. In living material of *V. pachyderma* the " Wanderplasm " is large and conspicuous and passes entirely back into the main filament; similarly with *V. aversa*. In *V. sessilis, V. pachyderma, V. aversa*, the basal wall of the oogonium is formed in from 15 minutes to an hour after the " Wanderplasm " has passed out, and from a few minutes to an hour before the oogonium opens.   A. G.

Halosphæra.—PIERRE DANGEARD (" Notes sur l'*Halosphæra viridis* Schmitz," *Le Botaniste*, 1932, **24**, 261–74, 2 pls.). An account of all that is known of *Halosphæra viridis* and of its wide distribution in oceanic waters. In 1928 the author had an opportunity of studying it in the Arctic Sea in waters beyond the reach of the Gulf Stream, and of observing the sporulation of the alga and its liberation of zoospores in a bay of Jan Mayen Island. The zoospores are provided with two unequal cilia. At the end of August the alga was abundant in the plankton among the icebergs of the east coast of Greenland; they were forming endogenous bodies which might be regarded as aplanospores, or better as resting spores. Kysts of another sort, yellowish-green, free and punctate have been found at Banyuls in winter and may belong to the evolutionary cycle of *Halosphæra*.   A. G.

Gigartinales.—HARALD KYLIN (" Die Florideenordnung Gigartinales," *Lunds Universitets Årsskrift*, 1932, N.F., Avd. 2, Bd. **28**, nr. 8, 1–88, 28 pls., 22 figs.). The results of an investigation of the developmental history of the Gigartinales. In this order are comprised the Calosiphoniaceæ, Nemastomataceæ, Furcellariaceæ, Sebdeniaceæ, Solieriaceæ, Rissoëllaceæ, Rhabdoniaceæ, Rhodophyllidaceæ, Hypneaceæ, Plocamiaceæ, Sphærococcaceæ, Stictosporaceæ, Sarcodiaceæ, Gracilariaceæ, Mychodeaceæ, Dicranemaceæ, Acrotylaceæ, Phyllophoraceæ, Gigartinaceæ. The author has investigated the sexual reproduction of the genera of all these families, and illustrates the results with numerous figures, many of which represent original specimens. The whole order is characterized by the fact that a normal intercalary thallus cell serves as auxiliary cell. The characters on which the families are arranged are made clear by a key. Similar keys are provided for the Nemalionales which lack a typical cell, and for the Cryptonemiales where typical auxiliary cells are present. The name Gigartinales has priority of Nemastomales as an ordinal name.   A. G.

Fucus ceranoides.—P. M. SKRINE, L. NEWTON, and E. H. CHATER (" A Saltmarsh Form of *Fucus ceranoides* L. from Llanbedr, Merioneth," *Ann. Bot.*, 1932, **46**, 769–79, 1 pl., 5 figs.). A description of the plant communities of the Mochr a

marshes, and an account of the morphology of *Fucus Ceranoides* ecad *proliferatus*, a new form which is characterized by the production of proliferations from some of the hair-pits on the margin of the thallus. This method of proliferation is described and figured.   A. G.

Laminaria gametophytes.—RACHEL HARRIES ("An Investigation by Cultural Methods of some of the Factors Influencing the Development of the Gametophytes and the Early Stages of the Sporophytes of *Laminaria digitata*, *L. saccharina*, and *L. Cloustoni*," *Ann. Bot.*, 1932, 46, 893–928, 3 pls., 13 figs.). An account of the experiments made in studying the effects of nutrition and light on the gametophytes of the three common species of *Laminaria*; the method of bringing the zoospores under culture; the constituents of the nutrient solution necessary for growth and development; the respective actions of KI, KH_2PO_4 and KNO_3; the renewal of supplies; the effect of light on the production of oogonia. The structure of the developing plantlets is abundantly figured in the plates.   A. G.

Desmarestiaceæ.—E. SCHREIBER ("Über die Entwicklungsgeschichte und die systematische Stellung der Desmarestiaceen," *Zeitschr. f. Bot.*, 1932, 25, 562–82, 12 figs.). An account of the development of the gametophytes of *Desmarestia aculeata* from zoospores in pure culture. The male and female gametophytes are described and figured. The development of the monosiphonous sporophyte is followed from germination up to the stage of cortex formation. The gametophyte stage resembles that in Laminariaceæ and Chordaceæ. The Desmarestiaceæ are regarded as an independent family in the Laminariales.   A. G.

Black Sea Algæ.—ST. PETKOFF ("Sur la flora algologique des côtes bulgares de la Mer Noire," *Bull. Soc. Bot. de Bulgarie*, 1932, 5, 117–27). Additions to the lists already published by the author in 1904, 1905, 1919 on the algæ of the Black Sea coasts of Bulgaria. The marine algæ comprise fourteen Florideæ, four Phæophyceæ, two Chlorophyceæ, one being covered with two species of diatoms. A complete list of all the species, freshwater and marine, hitherto recorded is added and includes 100 species and numerous varieties of diatoms.   A. G.

New Parasitic Pythium.—WILLY HÖHNE (*Mycologia*, 1932, 24, 489–507, 1 pl., 11 text-figs.). The fungus was obtained from a surface soil sample at the waterline of a pond in a meadow. The method of securing a pure culture is described—it was grown on ant larvæ and hemp seed, but the latter substance did not tend to easy observation. The mycelium is first described; then the formation of sporangia is followed: they are spherical or slightly oval and usually intercalary. Some form zoospores, others become resting sporangia; these latter form either zoospores or germ-tubes. The development of the sexual organs was also followed: they appeared after 36 hours on ant larvæ within a water dish. The oogonia are more or less similar to intercalary sporangia, the antheridia are formed from the adjoining parts of the hypha; an antheridium dissolves the wall of the oogonium and part of its plasma enters and in time oospores are formed. The species *Pythium epigynum* n.sp. was proved to be parasitic, affecting both seeds and seedlings of grass, etc.   A. L. S.

Species of Mortierella.—DOROTHY DIXON-STEWART ("Species of *Mortierella* Isolated from Soil," *Trans. Brit. Mycol. Soc.*, 1932, 17, 208–20, 8 text-figs.). The writer collected new fungi from sandy soil in Victoria. Eleven species were identified as *Mortierellæ*, five of them not previously described. A list of all soil species of known *Mortierellæ* is given and a description of the genus with the

reproductive organs, which, however, do not always occur.   An account of culture methods is given, followed by a detailed account of the new species, all of which were cultivated on soil media.   They were obtained from a very dilute soil suspension.   Reproductive organs did not appear on all the species.   A. L. S.

New Species of Olpidium.—KATHLEEN SAMPSON (" Observations on a New Species of *Olpidium* occurring in the Root Hairs of *Agrostis*," *Trans. Brit. Mycol. Soc.*, 1932, **17**, 182–93, 3 pls., 5 text-figs.).   The resting spores were discovered in the root-hairs of *Agrostis stolonifera* already infected with a fungus resembling *Pythium*.   Observations were made on living material and also on mounted specimens.   It was possible to describe in detail the development of the zoosporangia and of the escape of the spores ; these zoospores are more or less spherical with a long posterior cilium, they are invariably bi-nucleate at an advanced stage, probably due to copulation of zoospores.   Diagnosis and description is given of the new species *Olpidium Agrostidis*.   Explanation is given of the differences between it and other species on the higher plants.   A. L. S.

Philippine Fungi.—JOSÉ MIGUEL MENDOZA (" The Philippine Species of *Parasterina*," *Philippine J. Sci.*, 1932, **19**, 443–59, 15 pls.).   The large genus *Asterina*, founded by Lévcillé in 1845, has been split up to emphasize the presence or absence of paraphyses in the fruiting bodies : the larger number, of species having no paraphyses, are retained in the original genus ; in *Parasterina* Theissen & Sydow paraphyses are present.   Some few species are new, but most of these have already been described.   Mendoza, however, has given careful diagnoses and descriptions of the microscopic characters and of the appearance of the fungus on the leaves of the various hosts.   A. L. S.

Fructification in Aspergillus.—ADALBERT BLOCHWITZ (" Die Perithezien des *Aspergillus flavus*," *Hedwigia*, 1932, **72**, 55–7, 7 text-figs.).   The author found the perithecia on the under surface of an old bread culture ; they were distinguished by the thick complicated wall of several layers which are fully described.   The inside was occupied by colourless thin-walled asci, with six to eight spores, $12 \times 7\mu$.   Blochwitz has connected this fructification with *Aspergillus flavus*, and noted that the yellow mycelium of that species had penetrated the bread.   A. L. S.

Cultural Study of Aspergillus.—MARY LEE MANN (" Calcium and Magnesium Requirements of *Aspergillus niger*," *Torrey Bot. Club.*, 1932, **59**, 443–90, 13 text-figs.).   Much work has been done as to the most suitable nutrient solutions for fungi and the higher plants.   The author of this paper has worked mainly with solutions containing calcium and magnesium.   Cultures of *Aspergillus niger* and *Penicillium* sp. were grown in Pfeffer's three salt solution and results calculated from the weight of the total growth on felt, and from the amount of conidial formation.   Magnesium was found to be essential, though there is no requirement wanted for chlorophyll, it is as necessary for these fungi as for the higher plants.   Minute quantities of calcium were present in the cultures.   Other salts were supplied and their effect is described : the growth of *Aspergillus niger* was greatest in solutions that contained higher proportions of magnesium sulphate and lower proportions of ammonium nitrate than those of Pfeffer's solution.   The addition of a calcium salt seemed to have no pronounced influence on the growth of *Aspergillus*.   A. L. S.

Italian Laboulbeniæ.—SILVIA COLLA (" Una Laboulbeniale nuova per L'Italia : *Rachomyces Aphœnopsis* Th.," *Nuova Giorn. Bot. Ital.*, 1932, **39**, 512).   The author

calls attention to the rarity of this microscopic genus in Italy. The species in question was found on *Aphænops cerberus* in a grotto. The genus is distinguished by the sterile appendices that form a corona on the perithecium. A. L. S.

Study of Hysteriaceæ.—M. L. LOHMAN (" Three New Species of *Mytilidion* in the Proposed Subgenus *Lophiopsis*," *Mycologia*, 1932, 24, 477–84, 1 pl., 1 text-fig.). The species described occur on *Pinus*—on the old bark or decaying wood. The spores differ from other known species of *Mytilidion* and have been placed in the above subgenus ; they are much longer in comparison with their width than in the previously known species of *Mytilidion*. A. L. S.

Study of Sarcosoma.—K. B. BOEDIJN (" The Genus *Sarcosoma* in Netherlands India," *Bull. Jard. Bot. de Buitenzorg*, 1932, 12, 273–9, 1 text-fig.). The writer gives a comprehensive account of the genus as it occurs in the Dutch Indies, descriptions both of the genus and of the species ; the first known in the region is *Sarcosoma javanicum*. He has figured the asci and spores of the different species with their peculiar markings, and has drawn up a key to the four species belonging to the region. They grow on trees or rotten leaves, etc., and in some cases, as in *S. javanicum*, may give rise to witch-brooms. Asci and spores are rather large and colourless. A. L. S.

Study of Daldinia.—MARION CHILD (" The Genus *Daldinia*," *Ann. Miss. Bot. Gard.*, 1932, 19, 429–80, 8 pls., 4 text-figs.). The author gives first an historical sketch of the genus in botanical literature, then passes to a discussion of the diagnostic characters ; she divides the genus into two groups distinguished by the characters of the ectostroma, the formation of the perithecia, the type of spores, and other microscopical details. Thirteen species are described, with emphasis on the microscopic characters as determining features. Three new species are described. A. L. S.

Mahonia-Rust.—C. HAMARLUND (" Zur Biologie des *Mahonia-Rostes* (*Puccinia mirabilissima* Peck)," *Bot. Not.*, 1932, 401–16, 3 text-figs.). The author returns to a study of this species of rust. He discusses the distribution of the rust in Sweden, then describes the æcidia on the leaves and distinguishes it from some other æcidia also on the same host. He gives descriptions of the related spermogonia, uredo- and teleutospores—the two latter spores appearing in mixed soil. The influence of climatic factors is also discussed. A. L. S.

Reproduction in Rusts.—MABEL A. RICE (*Bull. Torrey Bot. Club*, 1933, 60, 23–50). The author reviews the whole subject of fertilization in Ascomycetous Fungi, Lichens, and Rusts. The work done by many students on each group is outlined and comparisons and differences pointed out. Finally, the author states that the nuclear problem differs considerably from that of the other groups. In rusts conjugate nuclei are the accepted fact of the diploid generation, and belong rather to the Basidiomycetes in which clamp connections insure non-sister nuclei. The conclusion is that many problems still require clearing up. A. L. S.

Study of Pestalozzia.—CLIVE CHRISTENSEN (" Cultural Races and the Production of Variants in *Pestalozzia funerea*," *Bull. Torrey Bot. Club*, 1932, 59, 525–44, 6 text-figs.). The writer found the fungus growing on the leaves of *Pinus palustris* which had been killed by the parasitic fungus *Septoria acicola*. Many spores of the *Pestalozzia* were cultured and in some of them variants occurred ; at least a dozen distinct races could be distinguished by their growth characters—colour of mycelium, presence or absence and the form of spores, etc. These races have

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been grown on artificial media for more than a year without appreciable variation, though some races are unstable. The pathogenicity of this species of *Pestalozzia* has also been tested and seven conifers were inoculated with spores of the different races; none of them were parasitic under the conditions of experiment.

<div align="right">A. L. S.</div>

New Russula.—E. J. GILBERT ("*Russula rhodella* nov. sp.," *Bull. Soc. Mycol. France,* 1932, **48**, 109–11, 1 pl.). Gilbert gives a coloured plate of his new *Russula* with a detailed account of the colour, manner of growth, and the microscopic size and appearance of gills and spores. The species grows in beech woods.

<div align="right">A. L. S.</div>

Study of Inocybe.—R. KUHNER and J. BOURSIER ("Notes sur le genre *Inocybe,*" *tom. cit.,* 118–61, 31 text-figs.). The authors have made a careful microscopical study of certain species selected from four sections of this genus : (1) *Cortinatæ,* (2) *Calosporæ,* (3) *Petiginosæ,* and (4) *Rubellæ.* They give measurements and drawings of cystidia and spores, and group the species according to the size and form of these microscopic bodies.

<div align="right">A. L. S.</div>

Fungi of Asia-Minor.—A. PILAT ("Contribution a l'étude des Hymenomycetes de l'Asie Mineure," *tom. cit.,* 162–89, 9 pls.). Pilat has confined this first contribution to the Polyporaceæ. He gives first the character of the country : the mountains and woods that influence the fungus growths. He describes a large number of species—their outward appearance and in every case the microscopic dimensions of pores, and of the spores. Many genera are included in the survey. The plates are photographic.

<div align="right">A. L. S.</div>

The Genus Protodontia.—G. W. MARTIN (*Mycologia,* 1932, **24**, 508–11, 2 text-figs.). Martin writes this paper to clear up the confusion between the genera *Protohydnum* and *Protodontia.* The first-named was diagnosed by Möller from a Brazil species in 1805. The writer considers it a valid genus, but it has been confused with a *Protodontia* species described by Von Höhnel as *P. uda.* Martin inclines to retain both genera and gives the distinctive differences, including the character of basidia, spores, etc. He finds that *Protodontia uda* is a widely distributed species.

<div align="right">A. L. S.</div>

Life-Cycle of Coprinus.—CHOW CHUNG HWANG ("Le cycle evolutif du *Coprinus tomentosus* Fries & Bulliard," *Le Botaniste,* 1932, **24**, 187, 3 pls.). The study follows the development of the whole plant in its microscopic characters. (1) The mycelium from the spore germination and the formation of clamp hyphæ to the fruiting bodies—sclerotia and rhizomorphs—as seen in nature and in cultures. (2) The formation of öidia is described and of the carpophores with a detailed account of basidia and spores. (3) The nuclear characters are also described ; the young basidia possess two haploid nuclei which fuse, thus forming a diploid nucleus, the only sexual stage.

<div align="right">A. L. S.</div>

Sidia of Coprinus.—H. J. BRODIE ("Öidial Mycelia and the Diploidization Process in *Coprinus lazopus,*" *Ann. Bot.,* 1932, **46**, 727–32). Brodie in this paper adds to our knowledge of the different spore systems in Basidiomycetes, especially as regards the öidia. These are borne on öidiophores produced on haploid, never on diploid mycelia, but they may be transferred by insects to mycelia derived from spores of the opposite sex. The mycelia of one sex only may grow indefinitely without producing fruit bodies, but if of opposite sexes the mycelia may fuse and

produce diploid mycelia, and a basidiosporous mycelium is able to diplodize an öidial mycelium of opposite sex. A. L. S.

Study of Melanogaster.—E. MARTIN-SANS and TH. MATHOU ("Note sur le *Melanogaster variegatus* (Vitt.) Tul. var. *Broomeanus* (Berk.) Tul.," *Bull. Soc. Bot. France*, 1932, 48, 190–95, 1 col. pl.). The authors took occasion of the finding of this underground fungus which turned up among truffles to make a microscopic examination hitherto very incomplete. They note the formation of the dark-brown gleba, the thin peridium, the basidia, and the spores; the basidia are clavate, 20μ to 30μ long, a larger size than was recorded by Coker and Couch, but otherwise similar in character. A. L. S.

Confusion of Nomenclature.—MALCOLM PARK ("*Tuber zeylanicum* B. & Br. and *Sclerotium Rolfsii* Sacc," *Trans. Brit. Mycol. Soc.*, 1932, 17, 179–81, 1 pl.). The writer describes these sclerotia-like bodies which have frequently been confused with each other. It has now been established that *Tuber zeylanicum* B. & Br. stands for the fungus first named as such, and that *Sclerocystis coremioides* B. & Br. is also a definite species. These two had been placed together under *Sclerotium zeylanicum*. There remains *Scl. Rolfsii*, a third species, at first supposed to be identical with *Tuber zeylanicum* but now distinguished as *Sclerotium Rolfsii*, that name having priority over *Scl. zeylanicum*. A. L. S.

Variation in Fungi.—H. N. NANSEN and RALPH E. SMITH ("The Mechanism of Variation in Imperfect Fungi: *Botrytis cinerea*," *Phytopathology*, 1932, 22, 953–64, 4 text-figs.). The authors have set out to explain the variability of *Botrytis cinerea*. Numerous samples of the fungus were collected in California and grown in cultures producing many morphological strains. From these strains single spore-cultures were grown through several generations, some of them remaining true but others breaking up into further variations giving rise to various culture types. The causes of this excessive variation in culture are the multinucleate cells and conidia, and the anastomosis of hyphæ by which nuclei migrate into the cells of different strains, giving rise to cells and spores again containing genetically different nuclei. It is suggested that the unit is the nucleus and not the cell—that the multinuclear spore is not an individual but a colony, and can thus give rise to different cultures. A. L. S.

Ultra-violet Rays and Spore Formation.—ALICE ALLEN BAILEY ("Effects of Ultra-violet Radiation upon Representative Species of *Fusarium*," *Bot. Gaz.*, 1932, 94, 225–71, 1 pl., 6 text-figs.). This extensive work was undertaken as an aid to the systematy of the many species of *Fusarium* encountered in the investigation of plant diseases. The macrospores being the most representative characters, though often absent, it was thought that some means of inducing their growth might be helpful in the discriminating of species. Ultra-violet irradiation had already been found useful in similar work, and even the failure to induce macrospore formation may be of use in the verification of species. In most of the fifty-nine species cultured and exposed to ultra-violet rays there was an increase in total sporulation after treatment. All of the species which responded to the rays were saprophytes. The known parasites failed to show increased macrospore formation. Much attention was given to the management and changes of the rays, the waves of which were differently transmitted. A full account is also given of the time exposures and the immediate effects. In only one instance were perithecia formed and that was two months after irradiation. A full account of the separate radiation experiments is given. A. L. S.

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Growth Conditions affecting Sporulation.—B. L. CHONA (" The Effect of Cultural Conditions on the Growth and Sporulation of an Organism belonging to the Group Species *Aspergillus glaucus*," *Trans. Brit. Mycol. Soc.*, 1932, **17**, 221–29). The author attacked his problem by employing different media and by temperature observations. These are fully described. He found that the two leading factors in growth were the concentration of the medium, chiefly as regards sugar, and the degree of illumination. Under starved conditions growth and sporulation were small. They revived under increase of concentration up to a point beyond which conidial formation decreased, while growth and perithecial formation continued to increase. Strong illumination encouraged perithecial and vegetative growth, darkness had the reverse effect.   A. L. S.

Entomogenous Fungi.—T. PETCH (" A List of the Entomogenous Fungi of Great Britain," *Trans. Brit. Mycol. Soc.*, 1932, **17**, 170–78). " The list includes the entomogenous fungi (excluding Laboulbeniomycetæ) which have been previously recorded as occurring in Great Britain, and others which have been added in the years 1930, 1931." This list is comprehensive and of great historical interest, with dates as far back as 1760. Most of them are minute parasites on various beetles, wasps, flies, etc. Many of the new species were collected and diagnosed by the author, near to his home at King's Lynn. One new genus, *Syngliocladium* Petch, a member of the Stilbales, was found on a spider among dead leaves at St. Leonard's Forest, Horsham. In each case collector, locality, and date are given, as well as the fungus and its host.   A. L. S.

Fungi on Locusts.—GAUDENCIO M. REYES (" An Unreported Fungous Disease of the Philippine Migratory Locust," *Philippine J. Sci.*, 1932, **49**, 407–18, 5 pls.). The fungus in question, *Beauveria globulifera* (*Sporotrichum globuliferum*), is a fairly widespread fungus and was determined as attacking the Philippine migratory locust on which it proved to be highly pathogenic. The fungus is characterized by its globose conidia and by a white cottony growth in culture media. Full descriptions are given of the fungus and of its effect on the locust. Hopes are entertained that it might be an aid to combat the locust plague.
                                                                  A. L. S.

Fungi on Coconut Leaf Miner.—GAUDENCIO M. REYES (" Artificial Infection of the Coconut Leaf Miner with *Beauveria globulifera* (Speg.) Picard," *tom. cit.*, 419–41, 5 pls.). Reyes, having noted the deadly effect of the *Beauveria* fungus, made experiments with it on the coconut leaf miner. He describes at length what is known as to fungi that attack the " miner " ; he concluded that there were various factors in the case—weather, climatic conditions, numbers of the insects, etc. He has proved, however, that the insect can be infected and killed, but more extensive experiments require to be made. The viability of the spores is of importance as giving longer chances of infection. The various means of spreading the infection are described ; spraying has so far proved to be the most effective way.   A. L. S.

Wood Pulp Fungi.—HÅKON ROBAR (" Fungal Infection in Norwegian Wood Pulp at Wood Pulp Mills," *Myt. Mag.*, 1932, **71**, 185–330, 32 text-figs.). Material for this investigation was collected from various wood pulp mills and experiments were carried out at the Botanical Laboratory, Oslo. It has been often stated that wood pulp suffered from fungal infection affecting the colouring of the material or altering its consistency. The fungi on the pulp were isolated by Robar and cultured ; about sixty species of microscopic fungi altogether were determined,

the larger number being Hyphomycetes and other Fungi Imperfecti, along with a smaller number of Ascomycetes and Mucorini. Hymenomycetes are the most important cause of rot on pulp, but they were not found on any pulp inside the walls of a mill. Any rot was probably due to contamination from the wood-work, etc., during storage. Possible sources of contamination from air, water, etc., are discussed. All the fungi found have been described and many of them figured; several new species were determined. The author, arguing from his results, finds that moulds ordinarily appearing on wood pulp are as a rule of no importance as fibre destroyers. He has also decided that air was a more important source of contamination than either timber (stacked near by) or water.　　　　A. L. S.

Notes on Chinese Fungi.—F. L. TAI (*Nanking J.*, 1932, 2, 171–79, 23 figs.). These notes give descriptions with figures of eighteen microscopic fungi, a number of them Uredineæ. A full account is given of them—their appearance in the field, details of development, and spore forms. Their significance as parasites is also included in the descriptive survey.　　　　A. L. S.

Causative Agent of California Disease.—MORRIS MOORE (" Coccidioidal granuloma : A Classification of the Causative Agent, *Coccidioides inimitis*," *Ann. Min. Bot. Gard.*, 1932, 19, 397–427, 1 pl.). Moore has fully described the occurrence and character of this disease as it attacks man or animals. He has definitely traced the organism by cultures to a fungus growth nearly allied to Endomycetaceæ and Saccharomycetaceæ. In the tissues it exists in the form of a sphere ; in cultures it forms hyphæ which reproduce by endosporulation. The microscopic details are given as to form and size, and also the reactions of the fungus to staining. Moore has determined the genus, with two species. It is apparently endemic in California.　　　　A. L. S.

Cercospora Disease of Beans.—R. C. WOODWARD (" *Cercospora Fabæ* Fautrey on Field Beans," *Trans. Brit. Mycol. Soc.*, 1932, 17, 195–202, 1 pl.). This species of a Hyphomycetous genus is distinguished by the long brown septate spores. It forms dark spots on the leaves of the bean and attacks more readily wounded areas ; it has also been observed on the stems. Cultures of the fungus were made and a series of inoculation experiments carried out, all proving the damage done to the plants. It is world-wide in distribution, and since 1927 it has been found at many places in England.　　　　A. L. S.

Elsinœ Disease of Apples.—ANNA E. JENKINS (" *Elsinœ* on Apple and Pear," *J. Agric. Research*, 1932, 44, 689–700, 3 pls., 1 text-fig.). Jenkins discusses every aspect of this disease now recognized as due to *Pirodiscella* the earliest name of the fungus. It causes an anthracnose on leaves and fruit of apple and pear, reported from Europe and S. America and N. America, but not as yet in the United States. Cultures have been made and an account is given of the microscopic characters as observed in the conidial (*Sphaceloma*) and ascogonial stages (*Plectodiscella*). The synonymy of the fungus has been examined and cleared up, as well as the development of the disease.　　　　A. L. S.

Root Pythium.—GWENDOLYN M. CHENEY (" *Pythium* Root Rot of Broad Beans in Victoria," Austral. *J. Exper. Biology and Medical Sci.*, 1931, 10, 143–55, 6 text-figs.). In recent years much damage has been done to broad beans around Melbourne by the fungus *Pythium Fabæ* n.sp. It destroys the root-system of the bean plants and the effect is very visible when flowering begins. A blackening of the base of the stem indicates the disease. In the tissues of the host the mycelium was found to be abundant in or between the cells and more particularly in the

vascular system. Along with the fungus a Nematode, *Diplogastes œrivora*, was constantly associated with the fungus in the roots and more particularly in the outer cortical cells. The fructifications of the fungus were described and figured with an account of the fertilization process and the formation of oogonia and oospores. Inoculation experiments confirmed the diagnoses of the disease. Six weeks after inoculation signs of the disease were seen on the plants.   A. L. S.

Potato Wilt Disease.—B. L. CHONA ("The Occurrence in England of a Potato Wilt Disease due to *Fusarium oxysporum* Schlecht," *Trans. Brit. Mycol. Soc.*, 1932, **17**, 229–35, 1 pl., 1 text-fig.). The diseased plants were discovered during the growing season at Wye, Kent. The plants attacked showed a wilted appearance in the haulms. An examination of the *Fusarium* in the field and in cultural conditions was carried out and the results are recorded. Not only growing plants but also tubers were susceptible to the disease and were rotted by the fungus. The disease appears in high temperatures ; it is common in the Southern American States, but rather rare in England and on the Continent.   A. L. S.

Botrytis Disease of Iris.—H. H. WHETZEL and F. L. DRAYTON ("A New Species of *Botrytis* on Rhizomatous *Iris*," *Mycologia*, 1932, **24**, 469–76, 2 pls., 1 text-fig.). The disease described has been noted in Europe and America for several years, more especially on imported rhizomes of *Iris*. It is variously known as " rhizome-rot " or " crown-rot." Evidence points to the attack of the fungus as a wound-parasite. Cultures of the organism showed it to be a new species ; the sclerotia are shining black, convolute, and agglomerated up to 18 × 16 mm. in size. No apothecial fruit bodies have as yet been observed. *Botrytis convoluta* n.sp. is the name given.   A. L. S.

Rose Disease.—ANNA E. JENKINS and R. P. WHITE ("Identification of *Diaporthe umbrina* on Rose from England," *tom. cit.*, 485–88, 2 pls.). The fungus has been known for some time as a canker of roses in America. Recently it has been reported from Cheltenham, England, and has been identified with the fungus in the United States by the authors of this paper. Cultures were made of the English fungus and compared with cultures in America, which proved the cause of the disease to be due to the already known *Diaporthe umbrina*.   A. L. S.

Wilt Disease.—J. J. TAUBENHAUS and W. N. EZEKIEL ("*Sclerotinia* Wilt of Greenhouse Snapdragons," *Amer. J. Bot.*, 1932, **19**, 808–11, 1 text-fig.). The disease appeared in a commercial greenhouse in Texas, killing about 60 p.c. of the Snapdragon plants. The cause of the disease was finally traced to *Sclerotinia Sclerotiorum ;* it appeared first as water-soaked lesions developing next as white mycelial growth and sclerotia. These sclerotia were cultured by first drying and then burying in soil for fourteen weeks, when apothecia with asci and spores resembling those of *S. sclerotiorum* appeared on the sclerotia. The source of infection has been surmised to be infected manure.   A. L. S.

Lichens.

Lichen Flora of Trees.—LUCY C. RAUP ("An Investigation of the Lichen Flora of *Picea canadensis*," *Bryologist*, 1930, 33, 1–11). The author postulates the following problems : the distribution of lichens on the tree, the age of the tree, and the possibility of reaching these epiphytes. The two trees investigated grew on the north shore of Great Slave Lake within 40 miles of tree limit. They were felled and systematically examined : No. 1 was 40 feet high, and judging from the

rings about 153 years old ; No. 2 was a smaller tree. It was found that lichens grew on all parts of the trees, all were represented on the lower parts, and nearly all grew on the upper sides of the branches. The earliest association was crustose followed by a foliose association (*Parmelia saxatilis*). Succession was practically the same on branches as on trees. A list of species with their exact position is given ; fourteen in all are recorded. *Buellia parasema* (*B. disciformis*), a crustose lichen with dark septate spores, was the most widely distributed species on the trees. *Parmelia physodes* was confined to the base of the trees. Fruticose species were abundant on dead branches, on which there was a slightly larger number of species, possibly owing to the disappearance of twigs, etc. Two species of *Buellia* were the only crustose forms. *Xanthoria lychnea* was abundant.   A. L. S.

Swedish Lichens.—A. H. MAGNUSSON (" New or Interesting Swedish Lichens, VII," *Bot. Not.*, 1932, 417–44). Magnusson's notes are distinguished by the careful microscopic descriptions of the various species, both new and old, and the comparisons with other related forms, most of them minute and crustaceous. He describes a new variety of *Evernia prunastri* var. *bisoralifera* as having snow-white, half-globose soralia. He has added many new varieties to species already known, and has given detailed microscopic measurements of spores, etc., in all the species new or already known.   A. L. S.

Maritime Lichens.—H. DES ABBAYES (" Observations sur les lichens marins et maritimes du Massif Armoricain," *Bull. Soc. Sci. Bretagne*, 1931, Fasc. III, IV, 1–9). In this paper Abbayes has outlined the scope of a larger work to be published later ; he gives his reasons for this preliminary work. The region selected for exploration was the Northern French Coast south of Erquy. The constitution of the rocks is given and its effect on lichen growth. He distinguishes five zones : the lowest that of *Lichina pygmœa* situated between low and high tides. Above that the *Verrucaria maura* zone. Farther up *Caloplaca marina* zone, then *Xanthoria panetina;* finally the zone of Phanerogams and larger shrubby lichens. Microscopic study is required to distinguish most of the lichens. Some of them are exclusively marine (*Lichina* and *Verrucaria maura*). Others such as *Xanthoria parietina* are nitrophilous lichens found where there is a supply of nitrogen, such as on the rocks frequented by birds—a favourite habitat.
                    A. L. S.

Maritime Lichens.—AD. DAVY DE VIRVILLE (" La répartition des lichens a l'île de Cezembre," *Compt. Rend. Acad. Sci.*, 1932, **194**, 1180–82). The lichen flora on this island is saxicolous and differs markedly according to the orientation —to the north or the south. From the cliff heights to the sea the writer notes five zones : the lowest occupied by *Lichina pygmœa* which mingles with algæ such as *Fuci* and *Pelvetiœ*.   A. L. S.

Growth of Cladoniæ.—W. VOIGTLÆNDER-TELZNER (" Beobachtung über die Dauer des Wachstums der Cladonien an der Gaazfichten bei Arnswalde in der Neumark," *Hedwigia*, 1932, **72**, 144–47). The writer has been able to calculate the rate of growth in a pine wood (spruce) which had been cut down and replanted. In 5½ years there was an abundant growth of sixteen species with varieties ; where shade had become too dense one *Cladonia* species had died off.   A. L. S.

Lichens from the Antarctic.—VELI RASÄNEN (" Zur Kenntnis der Flechtenflora Feuerlands sowie der Prov. de Magallanes, Prov. de Chiloë und Prov. de Nuble in Chile," *Ann. Bot. Soc. Zool. Bot. Fenn. Vananio*, 1932, **2**, N. 1, I–VI,

1–65, 2 pls., 1 map). The object of the excursion was to make an ecological examination of moor and forest vegetation ; Räsänen took occasion to examine also the lichens flora. He brought home 1,500 specimens, which on examination provided 720 different lichen species described under fifty genera. In many cases full microscopic descriptions are given along with the general form and character, habitat, and locality. A number of species new to science are also diagnosed. There is an additional interest in the notes he gives of the contrast with forms from the far north. He found a considerable number of species, often with certain minor differences common to Arctic and Antarctic regions. He notes also affinity of species with New Zealand, but not with Australia, and argues that lichens did not easily cross the sea, but that New Zealand belonged to a great Southern Continent having a land connection with S. America.   A. L. S.

New Parmelia.—JOHN ADAM MOORE ("A New Species of *Parmelia* from Texas," *Ann. Miss. Bot. Gard.*, 1932, **19**, 503–4). Moore has given exact microscopical details of thallus and fructification of the new *Parmelia* collected in the mountains of Western Texas. It differs from *P. caperata* in being white-punctate and in giving no colour reactions with the usual chemical reagents.   A. L. S.

Japanese Lichens.—YASUHIKO ASAHINA ("Notes on Japanese Lichens," *J. Jap. Bot.*, 1932, **8**, English, 29–30, 7 text-figs.). Asahina is still occupied with Coniocarpineæ. He has now described *Pyrgillus boninensis* n.sp. and *Coniocybe luteum* n.sp., the appearance of the plants with their microscopic characters— thallus, apothecia, etc. Both species grew on old wood.   A. L. S.

Lichenological Contributions.—C. F. E. ERICHSEN ("Lichenologische Beiträge II," *Hedwigia*, 1932, **72**, 75–91). Erichsen describes a new species, *Physcia ocellata*, distinguished chiefly by the intense violet colour of the thallus-medulla on the application of potash (KHO) and also by the orange-red soralia. Another species, *Ph. violaria*, also new to science, is fully described in which the cortex, but not the medulla, became violet with KHO. It resembles *Ph. grisea*, but in addition to the violet coloration it differs in the form of the minute soralia which also show no reaction with potash. Critical notes are given on species of *Collema*, on *Lecanoræ* with yellowish-green thalli, and on a species of *Pertusaria*— *P. hemisphærica*—with a confusion of names. Finally he adds descriptions of *Lecanoræ* by A. H. Magnusson. All of the specimens were collected in or near Schleswig-Holstein.   A. L. S.

Apothecia of Thamnolia.—VELI RÄSÄNEN ("*Thamnolia vermicularis* (Sw.) Schær. mit Apothecien und Sporen gefunden," *Ann. Bot. Soc. Zool. Bot. Fenn Vanamo*, 1932, **2**, N. 6, 11–13). This lichen, so common in Northern Europe, has been classified with the *Imperfecti* owing to the absence of fructification. Räsänen found two fruited forms in a collection he made at Petsamo in 1931. The apothecia grow on the side of the upright thallus ; they are small, black, round, and without a thalline margin, with two colourless muriform spores. Räsänen considers that the form of the apothecia show affinity with *Roccella* rather than with *Usnea*. A Latin diagnosis of the fruit is given ; the spores measure $26\mu \times 10\mu$.
                    A. L. S.

Isidia on Verrucaria.—E. BACHMANN ("Über Isidien auf dem Lager einer epilithischen *Verrucaria*," *Ber. Deutsch. Bot. Ges.*, 1931, **49**, 110–14, 3 text-figs.). These isidia are peculiar in that they are the first to be observed on a typical lime-lichen. The species, *Verrucaria horizontalis* Zschacke, was found on limestone ; the structure of the thallus is given, with the scattered irregular outgrowths that

Bachmann has described. The tips of these isidia are lighter in colour owing to the thicker walls of the fungus hyphæ in the upper portion of the isidium.

<div align="right">A. L. S.</div>

Lichen Gonidia.—F. TOBLER (" Elfvings Untersuchungen über Flechten-gonidien," *Hedwigia*, 1932, **72**, 68–74). Tobler has here challenged the views published by Elfving in a recent paper as to the origin of the green lichen gonidia. Elfving there holds to his previous statements that they originate as green cells produced by the colourless hyphæ. Tobler entirely dissents from this ; he allows that greenish-coloured cells may arise in cultures of *Xanthoria*, but points out that Elfving nowhere has examined these cells by the spectroscope to determine the presence or absence of chlorophyll, nor has he tried to find any lichen acid such as parietin in these cells. Tobler decides that Elfving has entirely failed to establish his theory.

<div align="right">A. L. S.</div>

Lichens of Lappland.—GUNNAR NILSSON DEGELIUS (" Zur Flechtenflora des südlichsten Lapplands (Åsele Lappmark). I. Strauch- und Laubflechten," *Arkiv. för Bot.*, 1932, **25**, 1–72, 1 map, 8 text-figs.). Åsele Lappmark is the most southern part of Lappland—the writer considers it the least well-known lichenologically ; the plants now listed were collected mainly by the author. The province is entirely inland and a description of the land—hills, valleys, and woods—is given with the various geological formations. The different stations to which visits were paid are described. The lichens are given, according to locality, as universal (seventy-seven,) Northern (thirty-six), Alpine (twenty-seven), etc. Only the larger foliose and fruticose species are listed in this first paper under thirty-one genera, all Northern genera and species.

<div align="right">A. L. S.</div>

Cladoniaceæ.—EDUARD FREY (" Cladoniaceæ (unter Ausschlusz der Gattung *Cladonia*) und Umbilicariaceæ," L. Rabenhorst's Krypt.-Flora, 1932, *IX. Abt. IV.* 1, 1–208, 32 text-figs.). Frey gives in this part the genera of Cladoniaceæ omitting *Cladonia*. He gives a complete account of the European genera and a beginning of Umbilicariaceæ. The preface contains a general and comparative account of thalline and fruit development. The podetium, the most striking feature of Cladoniaceæ, he inclines to consider as decidedly part of the fruit formation ; he describes the different types of variation, but on the whole he regards it as a development of the hypothecium already formed in the primary thallus. As regards the pycnidia, he decides that pycnidia with pycnospores are established beyond doubt in some genera and species ; in others these bodies function as sexual spermagonia with spermatia. The whole evidence on these points is gone over by the author. The European genera are *Gomphillus, Icmadophila, Bæomyces, Stereocaulon,* and *Pilophoron,* also *Cladonia,* already published by Sandstede. *Stereocaulon* occupies most of the space with a large number of species, and is distinguished by the slender, branched podetia with variously formed squamules (phyllocladia) and, interspersed with these, darker-coloured Cephalodia. It is a genus of world-wide distribution.

<div align="right">A. L. S.</div>

<div align="center">Mycetozoa.</div>

Parasitism of Mycetozoa.—FRANK L. HOWARD and MARY E. CURRIE (" Parasitism of Myxomycete Plasmodia on the Sporophores of Hymenomycetes," *J. Arn. Arbor.*, 1932, **13**, 270–83, 2 pls., 2 text-figs.). Howard and Curry have made a study of plasmodia which they found on the fruit bodies of several of the larger fungi. Lister had already pointed out that the plasmodium of *Badhamia*

consumed the fruiting structures of several of the larger fungi. In the present investigations thirty-three different plasmodia were tested; the results in each case are given. The plasmodia actively digest the sporophores themselves or they leave the tissues over which they pass in a moist slimy condition, and thus an easy prey to bacteria and other fungi. They found also that the plasmodium carries on the digestion of the hyphæ close to the advancing margin; an examination of the fungus attached showed the gills becoming more and more eroded until there remained only a small mass of indigestible residue. A. L. S.

Parasitic Mycetozoa.—F. L. HOWARD and MARY E. CURRY ("Parasitism of Myxomycete Plasmodia on Fungous Mycelia," *tom. cit.*, **13**, 438–47, 1 pl.). The authors continue their observations on the plasmodia of certain Myxomycetes. The digestion of fungous mycelia by plasmodia has been incidentally noted by previous workers; it has now been scientifically worked out. The materials and methods are described—both the plasmodia and the fungi. They have found that the medium employed in their cultures is of great importance. The same plasmodia may flourish on the mycelium of one fungus and not attempt to attack that of another, and their difference is specific and not generic. In general, it is stated that "some Myxomycetes are restricted in choice of host while others seem to be generally mycophagous." They have proved that mycelia of a wide variety of fungi responsible for the decay of wood and debris are digested by the plasmodia of at least twenty-one Myxomycetes. A. L. S.

Myxomycete Fructification.—GLADYS E. BAKER ("A Comparative Morphological Study of the Myxomycete Fructification," *Univ. of Iowa Studies, Studies in Natural History*, 1933, **14**, 1–35, 8 pls.). The aim of this work has been to show the nature and exact relations of the chief structures of the mature sporangia, the walls, capillitium, columella, and stalk. Sixty-four species have been examined with reference to these characters, the material being taken mostly from the herbarium of the State University, Iowa. The writer describes her methods of soaking the specimens, cutting sections, and staining, etc., and a description of the fructifications along with figures are given of all those examined; they are representative of the sporangia and give the form, the outer wall, capilitium, etc. A. L. S.

Mycetozoa from Japan.—YOSHIKADZU EMOTO ("Über zwei noch nicht in Japan bekannte Myxomyceten," *Bot. Mag.*, 1932, **46**, 593–97, 4 text-figs.). Japanese with German résumé. The species described and figured are *Barbeyella minutissima* Meyl. and *Licea minima* Fr. Both species were collected on rotting wood. Descriptions, sizes of spores, etc., are given. The writer has also discovered the plasmodium of *Physarum nasuense*, a new species recently described by himself; it is orange-red in colour. A. L. S.

Notes on Labyrinthulæ.—P. A. DANGEARD ("Observations sur la famille des Labyrinthulées et sur quelques autres parasites des *Cladophora*," *Le Botaniste*, 1932, **24**, 217–58, 3 pls.). The Labyrinthulæ, parasites of sea-weeds, have been recognized as allied to the Acrasiæ and belonging to the Sorophæræ. Dangeard has reviewed the different genera and species, their recurrence and mode of life and reproduction. He finds that certain species absorb nourishment on the surface, others engulf solid substances into the interior. The effect of the parasite on the host differs also. It was found that a new species, *Labyrinthula Chattonii*, gave rise to swellings on the surface of the alga (*Cladophora refracta*) and to changes of

colour, the latter due to the ravages of the parasite on the chlorophyll granules. The original structure and appearance of the host alga is described in detail with the various distortions caused by the parasites. As a result of this intensive study Dangeard concludes that the Labyrinthulæ are akin to the Plasmodiophoraceæ as the Acrasiæ are allied to the Myxomycetes. Other parasites of *Cladophora*, with descriptions of new genera and species, are included in the paper along with members of the Chytridineæ, etc. The whole series of these parasites is depicted on the plates, and the microscopic characters are fully described and figured.

A. L. S.

TECHNICAL MICROSCOPY.

Control of Sap Stain and Mould in Southern Lumber.—R. M. LINDGREN, T. C. SCHEFFER and A. D. CHAPMAN (*Ind. Eng. Chem.*, 1933, **25**, 72–5). During the seasoning of many timbers, deterioration in market value (but not necessarily in strength) results from the formation of blue-coloured patches due to the growth of fungi, principally *Ceratostomella* sp. and some of the *Fungi imperfecti*. As a preventative measure, dipping in a solution of any of the following has been found to have practical possibilities : borax, ethyl-mercury chloride or phosphate, sodium tetrachlorophenoxide and sodium *o*-phenylphenoxide. The cost of such treatment was limited to 20 cents per 1,000 timber feet.   A. H.

Methods for the Identification of the Coloured Woods of the Genus Eucalyptus.—H. E. DADSWELL and M. BURNELL (*Bull No.* 67, *Division of Forest Products* (*Australia*), *Tech. Paper No.* 5, 50 pp.). This work covers the examination of thirty-seven species of *Eucalyptus* by macro- and microscopical methods with a view to establishing methods for identifying those Australian timbers now of some commercial importance. The text is illustrated with thirty-four plates, the majority of which show the transverse and tangential sections of the timbers. Each wood is accurately described, and a key is given at the end of the report indicating the method of identification, based first on basic density determinations, and then on microscopical characteristics.   A. H.

Measuring Microscope for Rubber Specimens.—R. E. LOFTON (*Ind. Eng. Chem. Anal. Edit.*, 1932, 434). The author advocates the use of a low-power microscope fitted with a × 6 micrometer eyepiece and objectives of 48 and 32 mm. focal length, for the measurement of the dimensions of dumb-bell shaped rubber test-pieces as used for tensile strength tests. The specimen can be held between two slides held together by spring bronze clips, or between two thick slides bearing adjacent external grooves over which are placed rubber bands. Measurements can be made from both sides of the sample without removal from the holder. It is shown that rubber specimens cut with a die vary in top and bottom width by 0·10–0·15 mm., and which might result in a 2 p.c. error in calculating tensile strength. The bottom widths are usually larger than the die. The importance of accurate measuring is emphasized.   A. H.

Studies of the Physiology of Moulds. III. Moulding of Pickled Sheepskins.—I. H. BLANK (*J. Amer. Leather Chem. Assoc.*, 1932, **27**, 380–92). Moulds were isolated from pickled sheepskins which had been treated in a sulphuric acid and common salt pickle liquor, although none were found in the liquors themselves. The chief types of mould were of the *Dematiaceœ* (*Hormodendrum* sp.) and the *Mucedinaceœ* (*Penicillium* and *Oidium* or *Monilia* sp.). As well as producing coloured defects on the skins which may persist throughout the entire tanning processes, some of the moulds are also proteolytic, and thus able to digest the hide protein. The presence of acetic acid in the pickle appears to inhibit the

growth of the moulds, as also does the presence of p-nitrophenol. Two suggested liquors for pickling skins are NaCl 6 gm., H_2SO_4 1·5 gm., and sodium acetate 1 gm. per 100 c.c., or instead of this latter 0·025 gm. p-nitrophenol. Seven plates illustrate the text.   A. H.

The Polarising Microscope in Porcelain Investigations.—H. HERLINGER and A. UNGEWISS (*Sprechsaal*, 1932, 571; *ibid.*, 589). The authors demonstrate the use of the polarizing microscope for following the changes in the mineral constituents during the firing of porcelain. The disappearance of feldspar and kaolin can be traced, and generally speaking, information can be obtained much more rapidly than by chemical examination.   A. H.

Castor Seed in Feeding Stuffs.—F. ROBERTSON DODD (*Analyst*, 1932, **57**, 488–92). From 250 to 500 gm. of the sample are treated with 500 c.c. 1·25 p.c. sulphuric acid, washed by decantation and then treated with 300 c.c. of 1·25 p.c. caustic soda solution. After washing again thoroughly, the fibres are bleached for not more than 1 hour in a bleaching powder solution containing 1 p.c. available Cl. When bleached and washed the black particles are carefully separated by hand. The residue is washed rapidly with dilute HCl to remove all hypochlorite and again picked over. The black particles are then examined microscopically. Grape and raisin seed, both harmless, and croton and curcas seed, both very poisonous to cattle, may be mistaken for castor seed. Black grape seed turns purple with sulphurous acid, while castor seed remains black for a long time. The husks as separated can be treated with 50 c.c. of 0·5N HCl and 4 gm. $KClO_3$ on the water bath for 1 hour, after which the palisade cells of curcas can be detected readily. The paper is illustrated with six microphotographs.   A. H.

NOTICES OF NEW BOOKS.

The Marine Shells of Port Alfred, S. Africa.—By Lt.-Col. W. H. TURTON, D.S.O. 1932. xvi + 331 pp., 70 plates. Published by Mr. Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 18s. net.

Faune de France. No. 25. Éléments d'une Faune des Myriapodes de France. Chilopodes.—By H. W. BROLEMANN. 1932. xx + 405 pp., 481 text-figs. Published by Paul Lechevalier, 12, Rue de Tournon, Paris (VIe), France. Price 100 fr.

A Monograph of the Recent Cephalopoda, Based on the Collections in the British Museum (Natural History). Part II. The Octopoda (excluding the Octopodinæ).—By G. C. ROBSON, M.A. 1932. xi + 359 pp., 6 plates, 79 text-figs. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 20s.

Index Animalium.—By C. D. SHERBORN. Part XXVII. Index *Trichoscelis-variegatus*, pp. 6583–806. October, 1931. Part XXVIII. Index *variegatus-zizyphinus*, pp. 6807–7056. February, 1932. Part XXIX. Epilogue, Additions to Bibliography, Additions and Corrections, Index to Trivialia under 'Genera, pp. 1–208. June, 1932. Part XXX. Index to Trivialia under Genera, pp. 209–416 (*Atherina-Dia*). August, 1932. Part XXXI. Index to Trivialia under Genera, pp. 417–654. November, 1932. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 10s. each part.

Zeiss Nachrichten.—Edited by Prof. Dr. E. HAUSER. Part 2. December, 1932. 32 pp., 25 figs. Published by Carl Zeiss, Jena, Germany.

Transactions of the Bose Research Institute, Calcutta. A Record of Research Carried on in Various Branches of Science. Vol. VII, 1931–32.—Edited by Sir JAGADIS CHUNDER BOSE, F.R.S. 1933. vi + 343 pp., 161 text-figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 25s. net.

Watson's Microscope Record. No. 28.—January, 1933. 24 pp., 13 figs. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

Practical Microscopical Metallography.—By RICHARD HENRY GREAVES, D.Sc., and HAROLD WRIGHTON, B.Met. 2nd edition, Revised and Enlarged. 1933. xi + 256 pp., 311 figs., including 54 plates. Published by Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 18s. net

Clothes Moths and House Moths. Their Life-History, Habits and Control.
—By Major E. E. AUSTEN, D.S.O., and A. W. McKENNY HUGHES, D.I.C. 1932. 56 pp., 20 figs. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 6*d*.

The History of the Microscope, Compiled from Original Instruments and Documents, up to the Introduction of the Achromatic Microscope.
—By REGINALD S. CLAY, B.A., D.Sc., F.Inst.P., F.R.M.S., and THOMAS H. COURT. 1932. xiv + 266 pp., 164 illustrations. Published by Charles Griffin & Co., Ltd., 42, Drury Lane, London, W.C.2. Price 30*s*. net.

Both authors are well known to the readers, as they have already contributed several historical papers to this Journal. They now publish a highly important book on the history of the microscope.

The space is wanting for pointing out in detail the great merits of this book. Whosoever knows the principal object of my valued friend, Mr. T. H. Court, may expect a thorough knowledge, especially of the masterpieces brought out by different old London opticians. The principal stress has been laid on the development in the seventeenth and the eighteenth centuries. To mention only the most famous opticians, the names of R. Hooke, J. Wilson, J. Marshall, E. Culpeper, J. Cuff, B. Martin, G. Adams should be consulted, as I suppose that even an experienced collector may find there valuable additions to his stock of knowledge. As the optical system of the microscope was still in its infancy, the more important improvements were at that time developed for the stand and all its different parts. The attentive reader will gratefully accept the wonderfully complete instruction conveyed to him by the authors.

The book contains a masterly exposition of the splendid technical growth of the London optical masters between 1660 and about 1820. They began as spectacle makers and by a very fortunate development became universally acknowledged artists in the whole optical art : spectacles, microscopes, telescopes, and cameræ obscuræ included.   M. v. R.

The Food of Protozoa.—By H. SANDON, M.A., Ph.D. 1932. (Publications of the Faculty of Science, Egyptian University, No. 1.) ii + 187 pp. Published by the Egyptian University. Price Piastres 20.

The secondary title describes this as a reference work for use in studies of the Physiology, Ecology, and Behaviour of the Protozoa. It is designed to obviate in some degree the difficulty which constantly recurs at the outset of any detailed study of the life, the habits, and the reactions of a particular protozoan under laboratory conditions, the difficulty of settling in advance the diet on which the subject organism is to be fed throughout a more or less prolonged period. In the absence of personal experience of a parallel case, the inquirer must ascertain as nearly as possible not only what appears to be the natural food, but also what food has been supplied by previous investigators and with what success. To provide this information in a readily accessible form is the aim of this book. From a multitude of sources, the author has brought together the actual nutriment observed, whether natural or supplied, in a great variety of researches, and has arranged both facts and comments according to the place in classification of the subject of the study reported upon. A separate section is devoted to each order of the three classes of protozoa. Indexes are provided for specific and other names and for subjects discussed or referred to. A bibliography of some thirty pages contains the titles of 447 works, mostly of recent date, which are arranged under the several headings of General, Flagellata, Rhisopoda, and Ciliophora.

                                                                                D. L. B.

Lehrbuch der Histologie und Histogenese.—By Josef Schaffer. 3rd edition. 1933. viii + 576 pp., 14 coloured plates, 640 text-figures. Published by Wilhelm Engelmann, Leipzig. Price 18 RM. unbound 20 RM. bound.

This text-book, written by the Professor of Histology in the University of Vienna, has now, after an interval of ten years, reached a third edition, which is said to have undergone thorough revision.

No more tragic example of the effect of political upheaval and economic isolation could be cited than the work under review. So far as the author is concerned, histological research in English-speaking countries apparently ended in 1914. Of more than 800 references to original sources less than 5 p.c. refer to British or American workers, while only six are of English or American publications later than 1918.

Kendall's suggestions on the constitution of thyroxin, first published in 1913, are mentioned, but Harington's work is ignored. Chambers seems to have ceased work on microdissection in 1921. Examples might be multiplied. Many of the illustrations are excellent; others are of archæological rather than histological interest.   G. M. F.

Man and Microbes.—By Stanhope Bayne-Jones, M.D. 1932. (A Century of Progress Series.) x + 128 pp., 8 plates, 9 text-figs. Published by the Williams & Wilkins Company, Baltimore, Md., U.S.A. Obtainable from Baillière, Tindall & Cox, 7 & 8, Henrietta Street, Covent Garden, London, W.C.2. Price 6s. net.

Though bacteria were first discovered by Leeuwenhoek more than two hundred years ago, they were regarded almost as scientific curiosities till the beginning of the nineteenth century. Practically all our knowledge has been gained in the last hundred years. It is therefore most appropriate that a book on microbes should be included in a series dedicated to the progress of knowledge during the past century. In simple yet felicitous language the writer describes protozoa and bacteria, their manifold activities in the production of disease, their rôle in the fertilization of the soil, and their use in countless industrial processes. The illustrations add much to the interest of an entertaining little book.   G. M. F.

A Manual of Bacteriology, Medical and Applied.—By R. T. Hewlett, M.D., F.R.C.P., D.P.H., and James McIntosh, M.D., B.Ch. 9th edition, 1932. ix + 746 pp., 43 plates, 66 text-figs. Published by J. and A. Churchill, 40, Gloucester Place, Portman Square, London, W.1. Price 18s. net.

The ninth edition of this excellent work will be welcomed by all workers in bacteriology, many of whom were brought up on the previous editions, the first of which was published in 1898. The science of bacteriology advances rapidly, so that with each new edition much new work has to be incorporated. After a while the addition of new matter to the old throws the book out of proportion and makes it patchy. Sooner or later drastic alterations have to be made, the book must be almost re-written, and the additions to the former editions given their true value. This is what has happened to the ninth edition, and the collaboration of Professor McIntosh has resulted in the authors producing a well-informed and reliable text-book.

The ordinary standard methods are dealt with completely. As one would expect from a Secretary of the Royal Microscopical Society, the chapter on the microscope is full and informative without being unduly long or complicated. The various bacteria are dealt with in detail and the descriptions particularly have been brought thoroughly up to date.

The book is especially valuable, however, for the concise and complete way in which the newer work on filterable and neurotropic viruses has been summarized and brought up to date. Professor McIntosh is a well-known worker in these fields, and the fruits of his work and knowledge are presented in an authoritative and readable manner. The chapter on diphtheria has been augmented, but more complete details of the virulence test and actual isolation of the diphtheria bacillus could have been given.

The chapter on undulant fever, contagious abortion, and tularæmia is short and concise, and the sero-diagnosis of syphilis, including the Kahn reaction, is admirably presented.

This edition can be well recommended to students, practitioners, and laboratory workers as a reliable, practical, and authoritative treatise on the ever-widening science of bacteriology.

J. E. McC.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIA-
TION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY,
DECEMBER 21ST, 1932, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT,
IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by
the President.

New Fellow.—The following candidate was balloted for and duly elected an
Ordinary Fellow of the Society :—

Prof. T. K. Koshy, M.A. (Madras).　　London.

Nomination Certificates in favour of the following candidates were read for
the first time, and directed to be suspended in the Rooms of the Society in the
usual manner :—

P. J. Gregory, M.A. (Madras).　　London.
Herbert Price.　　Bolton.

The Death was reported of :—

Ernest R. Dovey.　Elected 1919.

A vote of condolence with the relatives was passed.

Donations were reported from :—

Dr. Russell Coombe—

"How to Work with the Microscope." 3rd edition. 1865. By Lionel
S. Beale.

Mr. S. H. Robinson, F.R.M.S.—

"Microscopie Pratique." By G. Deflandre.
"Drops of Water." By Agnes Catlow.
"A Guide to the Study of Fresh-water Biology." By J. G. Needham
and P. R. Needham.
Various papers on Microscopy published in "Knowledge," 1881-5;
1903-11.

Société hollandaise des Sciences—

"Œuvres complètes de Christiaan Huygens." Tome XVII.

Verlag von Wilhelm Engelmann—

"Lehrbuch der Histologie und Histogenese." 3rd edition. By J. Schaffer.

M. Paul Lechevalier—

"Faune de France. No. 25. Chilopodes."

Messrs. Baillière, Tindall & Cox—

"Man and Microbes." By S. Bayne-Jones.

Oxford University Press—

"The Marine Shells of Port Alfred, S. Africa." By W. H. Turton.

Mr. F. W. Mills, F.R.M.S.—

£4 (Four pounds).

Mr. J. Rheinberg, F.R.M.S.—

£1 11s. 6d.

Mr. Conrad Beck, P.R.M.S.—

Special donation to Freshwater Biological Association of the British Empire—£1.

Votes of thanks were accorded to the donors.

New Council.—The Secretary read the By-Laws relating to the election of Council.

Nominations to serve on the Council for the ensuing year were read and approved.

Exhibits.—The following firms exhibited recent specimens of modern binocular microscopes :—Messrs. C. Baker, Bausch & Lomb Optical Co., Ltd., R. & J. Beck, Ltd., E. Leitz (London), C. Reichert, W. Watson & Sons, Ltd., Carl Zeiss (London), Ltd.

Votes of thanks were accorded to the exhibitors.

Papers.—The following communication was read :—

Dr. William R. Jones, D.Sc., F.G.S., M.I.M.M.—

"Examination of Opaque Minerals with Polarized Light."

A discussion followed in which the following gentlemen took part :—Mr. C. Beck (President), Mr. W. E. Watson Baker, Mr. F. A. Bannister, Mr. B. K. Johnson, and Mr. D. J. Scourfield.

7*.

The following paper was communicated by Dr. C. Tierney :—

Dr. Peter Gray, Ph.D., A.R.C.S.—

" Notes on the Practice of Fixation for Animal Tissues."

Hearty votes of thanks were accorded to the authors of the foregoing communications.

Announcements.—The Secretary made the following announcements :—

The Rooms of the Society will be closed from December 24th to December 28th, 1932.

The Biological Section will meet in the Pillar Room on Wednesday, January 4th, 1933.

The Annual General Meeting of the Society will be held on Wednesday, January 18th, 1933, when Mr. Conrad Beck, *C.B.E.*, P.R.M.S., will deliver his Presidential Address.

The Proceedings then terminated.

THE ANNUAL GENERAL MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIA-
TION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY,
JANUARY 18TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT,
IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

P. J. Gregory, M.A. (Madras).	London.
Herbert Price.	Bolton.
Dr. L. R. Waldron.	Fargo, N. Dakota.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

As Honorary Fellow, in recognition of his distinguished contributions to micro-metallurgical science :—

Sir Robert Hadfield, Bart., D.Sc., F.R.S., F.Inst.P.   London.

As Ordinary Fellows :—

R. Henry Bailey.	Beckenham.
John Ford.	Nigeria.
F. D. M. Hocking, M.B., B.Sc.	Caterham Valley.
E. Millson Walker, A.T.I.	Nottingham.
H. J. Young.	Morden.

Donations were reported from :—

Trustees of the British Museum—

"A Monograph of the Recent Cephalopoda. Part II. The Octopoda." By G. C. Robson.

"Index Animalium." Parts XXVII—XXX. 1931–32. By C. D. Sherborn.

Mr. S. H. Robinson, F.R.M.S.—

2 Powell & Lealand Substage Condensers and Stops.

1 Double Nosepiece, Frog Plate, and 2 Lieberkühns.

Votes of thanks were accorded to the donors.

The Annual Report of the Council for the year 1932 was read by the Secretary as follows :—

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1932.

FELLOWS.

It is with deep regret that the Council has to report the loss to the Society by death of twelve of its Fellows, including one of its past Presidents. Amongst the deaths reported are the following :—

George F. Bates.	Elected	1920.
A. Chaston Chapman.	,,	1903.
J. H. V. Charles.	,,	1921.
A. E. Charlton.	,,	1922.
E. R. Dovey.	,,	1919.
F. C. Dumat.	,,	1910.
W. Hepworth-Collins.	,,	1889.
Joseph Kitchin.	,,	1905.
Viktor H. Langhans.	,,	1930.
Joseph H. Scott.	,,	1916.

Twelve Fellows have resigned, and fourteen have been removed from the Roll of Fellowship in accordance with By-Law 31.

Twenty-three Ordinary Fellows have been elected to the Fellowship during the year, and five have been reinstated.

MEETINGS.

Eight Meetings of the Council and eight Ordinary Meetings of Fellows have been held, and the attendance has been well maintained.

An important meeting convened in the course of the Session for the special consideration of the microscopy of the filterable viruses was attended by a large number of distinguished visitors. A full report of this meeting has been duly published in the Proceedings of the Society, and the Council is much gratified to report that the preliminary description of the design and application of Mr. Barnard's ultra-violet microscope has been delivered during the Session, full details of which will be published in the forthcoming volume of the Society's Journal.

In connection with the Ordinary Meetings two exhibitions of modern instruments have been arranged during the Session, one of hand magnifiers, and one of modern binocular microscopes.

The Council has expressed its thanks and warm appreciation to the following firms for the loan of instruments and apparatus for use at the meetings :—Messrs R. & J. Beck, Ltd., and Messrs. W. Watson & Sons, Ltd.

JOURNAL.

Four quarterly parts of the Society's Journal have been published during the year, and it is worthy of note that the number of original communications which have been approved for publication is larger than in recent years. A special meeting of the Editorial Committee was convened at the request of the Council to consider the large number of papers in hand, and the Committee duly recommended that in view of the desirability of prompt publication of original papers, and its importance to the authors, a larger number than usual should be published in the December issue of the Journal, and that with a view to mitigating the high cost to the Society on account of printing, a portion of the Abstracts should be held over for publication in the next succeeding issue. The Committee further recommended that in view of the heavy strain upon the Society's financial resources involved in the production of costly plates illustrating some of the papers submitted, it was desirable that authors should be invited to contribute the cost of such plates where exceptional processes are required.

The thanks of the Fellows are due, and are hereby conveyed, to the Editorial Committee, the Panel of Abstractors, and the Editor, Dr. G. M. Findlay, for their valued services to the Society during the year.

LIBRARY.

The Library is in excellent order and condition, and while in consequence of the immediate necessity for economy it has not been found possible to continue for the moment the binding of periodical sets, this matter has not been lost sight of, and will be executed as soon as circumstances will allow.

The number of visitors to the Library during the year has been two hundred and twenty-three, and the number of volumes borrowed one hundred and thirty-six, excluding the large number of reference works referred to by workers visiting the Library. In addition to the foregoing, five volumes have been borrowed from the National Central Library to meet the requirements of Fellows, and fourteen volumes have been lent to the National Central Library.

Since the last Report fifty-five volumes have been added to the Library, in

addition to the normal accessions thereto received in exchange for the Society's publications.

Donations have been received from the following, which the Council has gratefully acknowledged :—Messrs. Baillière, Tindall & Cox, Messrs. Bausch & Lomb Optical Co., Ltd., Messrs. Blackie & Son, Ltd., Trustees of the British Museum, Mr. David Bryce, Cambridge University Press, Messrs. Chapman & Hall, Ltd., Messrs. J. & A. Churchill, Messrs. Comstock Publishing Co., Dr. Russell Coombe, Messrs. Cornish Brothers, Ltd., Dr. G. de Toni, Mr. A. Earland, Egyptian University Library, Verlag von Wilhelm Engelmann, Franckh'sche Verlagshandlung, Stuttgart, Prof. R. Ruggles Gates, Messrs. Charles Griffin & Co., Ltd., Mr. E. Heron-Allen, Herren S. Hirzel, Messrs. Howes Publishing Co., Mr. R. F. Hunwicke, M. Paul Lechevalier, Messrs. Longmans, Green & Co., Ltd., Mr. F. W. Mills, Oxford University Press, Sir Isaac Pitman & Sons, Ltd., Mr. S. H. Robinson, Société hollandaise des Sciences, Herr Julius Springer, Prof. S. B. Talmage, Dr. C. Tierney and Dr. Siegfried Türkel.

INSTRUMENTS AND APPARATUS.

The Society's Collection of Historical Instruments has been visited by a considerable number of English and foreign visitors during the year, especially in connection with the Centenary Meeting of the British Medical Association, which was held in London, and it is noteworthy that one of the recent accessions thereto —the microscope of Dr. Robert Ceely—has intimate association with the British Medical Association, as well as being of historical value to the Society's Collection.

Since the last Report the Council warmly acknowledges the following donations to the Collection :—

Dr. Russell Coombe—

1 Powell & Lealand Monocular Microscope, 1850, with inscribed stage plate presented to Dr. Robert Ceely, with accessories, in case.

Prof. A. Gandolfi Hornyold, F.R.M.S.—

4 Zeiss compensating eyepieces, × 2, × 6, × 8, × 12.
5 Zeiss apochromatic objectives, 16 mm., 8 mm., 4 mm., 2 mm., 1·5 mm.

Mr. Wm. Sanderson—

Portraits of Hugh Powell and Thomas H. Powell.
Society of Arts Silver Medal awarded to Hugh Powell, 1841, for his microscope design.
2 Antwerp Exhibition Medals, 1891, awarded to Powell and Lealand.
1 Simple Hand Microscope in case.

Mr. W. R. Traviss—

The original Traviss Expanding Stop.

In addition to the foregoing, the Society has acquired a new automatic projection arc lamp equipment for use at the meetings, and the whole Collection is now in good condition. Some repairs have been effected to the showcase in the Secretary's office, and a small repair by Messrs. W. Watson & Sons, Ltd., to instrument No. 247 has been gratefully acknowledged by the Council.

In view of the appropriate housing of the Society's Collection and of the increasing number and importance of the visitors thereto, the Council has extended an invitation to the makers of present-day instruments to exhibit examples of their

modern research and students' microscopes in the Society's exhibition cases, and it is hoped that makers will avail themselves of these facilities.

It is worthy of mention that, this being the tercentenary of the birth of Leeuwenhoek, to whom the science of micro-biology owes so much, it is a matter of profound regret to the Council that this Society does not possess one of the original microscopes of this great man in its Historical Collection. With a view to filling such gaps the Council would welcome information concerning old or historical instruments which may become available, some of which might not be adequately represented in the Society's Collection, and would be valued accessions thereto.

SLIDE CABINET.

The following accession has been added to the Slide Collection during the past year, for which the thanks of the Council have been accorded to the donor :—

Mr. S. C. Akehurst, F.R.M.S.—

Micro slide of *Eudorina elegans* (Forma globosa),

and twenty-eight slides have been borrowed from the Cabinet.

It is greatly to be desired that the Society should possess more adequate collections of paratype specimens of several of the important groups of microscopic organisms for reference by research workers. It is true that the Cabinet contains a large collection of slides of historical value ; nevertheless, the need for available representative collections of authenticated species slides of such organisms, for instance, as bacteria, diatoms, and other groups both in microscopic botany and zoology, is obvious, especially to those engaged in such studies, and it is with a view to fulfilling this necessity and increasing the reference value and usefulness of the Society's Collection to such workers, that the Council brings this important matter to the notice of Fellows having duplicate or spare collections for their earnest consideration. Fellows may be assured that such authenticated reference collections would, together with our unique Library, prove of inestimable value to workers engaged in the study of such groups, and it should be further observed that this Society, being the premier institution of microscopical studies, both pure and applied, is the appropriate repository for such collections.

The Committee appointed by Council to consider the standardization of biological stains and staining materials in this country has met to consider its constitution and procedure, and at the invitation of the Council the following bodies have appointed official representatives to serve thereon :—The Medical Research Council, Royal Society of Tropical Medicine and Hygiene, Chemical Society, Institute of Chemistry, Physiological Society, Pathological Society, and the Society of Chemical Industry.

The Council welcomes the formation and establishment of the Freshwater Biological Association of the British Empire, with laboratories on Lake Windermere, and although the Society is precluded by its Charter and Constitution from engaging in financial commitments thereto, a special fund has been opened for the voluntary payment of the annual subscription for the ensuing year.

No application has been received during the year for the use of the Society's table at the Marine Biological Laboratory, Plymouth.

The Council appointed Prof. R. T. Hewlett as Delegate to represent the Society at the British Medical Association Centenary Meeting.

The Council appointed the President to represent the Society at the Centenary Meeting of the Cambridge Philosophical Society.

The Society was also officially represented at the funeral of the late Mr. A. Chaston Chapman by the President.

APPENDIX.

BIOLOGICAL SECTION.

The Honorary Secretary of the Biological Section reports that the Section held five ordinary meetings in the Pillar Room during the year. These were well attended and the subjects brought forward were of much interest and often led to animated and instructive discussion. There was a slight improvement in the number of miscellaneous exhibits, but still more of these would be welcome. Two visits were also paid to Laboratories, namely, to the Bacteriological Laboratory, Guy's Hospital, and to the Physiological Laboratory, St. Bartholomew's Medical College. The best thanks of the Section are due to Prof. Eyre and Prof. Hartridge respectively for their kindness in allowing these visits to be made, and for the trouble taken to render them so successful.

On the motion of Dr. J. A. Murray, seconded by Mr. C. H. Bartlett, the following resolution was carried unanimously :—

" That the Annual Report be received and adopted."

It was further resolved, on the motion of Mr. C. D. Reyersbach, seconded by Dr. L. P. Clarke :—

" That a hearty vote of thanks be tendered to the Officers and Members of the Council for their services during the past year."

Mr. Conrad Beck, President, responded.

New Council.—The President having called upon the Secretary to read the By-Laws governing the election of Council, thereafter appointed Mr. H. Taverner and Mr. J. Richardson to act as Scrutineers of the ballot for the election of Officers and Members of Council for the ensuing year, and subsequently, upon receipt of the Scrutineers' report, declared the result of the ballot as follows :—

President.—Conrad Beck, C.B.E.

Vice-Presidents.—W. A. F. Balfour-Browne, M.A., F.R.S.E., F.Z.S., F.E.S. ; G. M. Findlay, O.B.E., M.D., D.Sc.; R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S. ; G. S. Sansom, D.Sc.

Hon. Treasurer.—C. F. Hill, M.Inst.M.M., A.Inst.P.

Hon. Secretaries.—J. E. Barnard, F.R.S., F.Inst.P. ; R. T. Hewlett, M.D., F.R.C.P., D.P.H.

Ordinary Members of Council.—D. M. Blair, M.B., Ch.B.; E. Hindle, M.A., Sc.D., Ph.D.; B. K. Johnson, D.I.C.; J. E. McCartney, M.D., Ch.B., D.Sc.; E. K. Maxwell, B.A.; A. More, A.R.C.S., A.R.T.C., F.I.C.; J. Rheinberg, F.Inst.P.; E. A. Robins, F.L.S.; D. J. Scourfield, *I.S.O.*, F.L.S., F.Z.S.; E. J. Sheppard; J. Smiles, A.R.C.S.; H. Wrighton, B.Met.

Hon. Librarian.—C. Tierney, D.Sc., F.L.S.

Hon. Curator of Instruments.—W. E. Watson Baker, A.Inst.P.

Hon. Curator of Slides.—E. J. Sheppard.

On the motion of the President, a hearty vote of thanks was accorded to the Scrutineers for their services.

Presidential Address.—Mr. Conrad Beck, C.B.E., then delivered his Presidential Address on :—

" Microscope Illumination with Transmitted Light "

at the conclusion of which, and on the motion of Mr. J. Rheinberg, seconded by Prof. R. Ruggles Gates, the following resolution was carried with acclamation :—

" That the best thanks of this meeting be accorded to Mr. C. Beck for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society."

The President responded.

Announcement.—The Secretary announced that the Biological Section would meet in the Pillar Room on Wednesday, February 1st, 1933, at 6 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY FEBRUARY 15TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected :—
As Ordinary Fellows of the Society :—

R. Henry Bailey. Beckenham.
John Ford. Nigeria.
F. D. M. Hocking, M.B., B.S., M.Sc., F.I.C. Caterham Valley.
E. Millson Walker, A.T.I. Nottingham.
H. J. Young. Morden.

As Honorary Fellow, in recognition of his distinguished contributions to micro-metallurgical science :—

> Sir Robert Hadfield, Bart., D.Sc., F.R.S., F.Inst.P. London.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

G. Dallas Hanna, Ph.D.	San Francisco.
John Gilbert Hare, M.D. (Gött).	Cambridge.
James Insch.	London.
Stephen John Matthews.	Sidcup.
K. L. Palmer, F.E.S.	Gobowen.

Death.—The President announced the regrettable loss to the Society by the death of its late distinguished Past President, Sir J. Arthur Thomson, elected to the Fellowship in 1885, the Fellows expressing their sense of condolence by standing in silence.

Donations were reported from :—

Messrs. Longmans, Green & Co., Ltd.—

> "Transactions of the Bose Research Institute, Calcutta." Vol. VII. Edited by Sir J. C. Bose.

Dr. G. de Toni—

> "Bibliographia Algologica Universalis." Part III. Bonnet-Bz. By J. de Toni.

Mr. R. A. Sheldrake, F.R.M.S.—

> "New Elements of Optics." By B. Martin. 1759.
> "The Museum of Science and Art." Vols. IX and X. 1856.

Mr. F. Adams, F.R.M.S.—

> "Diatoms : Their Collection and Preservation."

Mr. John A. Long, F.R.M.S.—

> 124 Species Slides of Diatoms.

Miss Kathleen M. Perry, B.Sc.—

> £14 (Fourteen pounds).

Votes of thanks were accorded to the donors.

Signing the Roll.—The following gentlemen present, having subscribed their signatures to the Roll of Fellowship, were received by the President, and duly admitted to the Fellowship of the Society :—

> Mr. E. E. Jelley.
> Mr. James Williamson.

Papers.—The following communications were read and discussed :—

Mr. Arthur S. Newman, F.R.P.S.

"A New Thorium Illuminant for Microscopy."

Mr. E. E. Jelley, B.Sc., A.I.C., A.R.P.S., F.R.M.S.

"Microscopy with Polarised Light."

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The Secretary announced that the Biological Section would meet in the Pillar Room on Wednesday, March 1st, 1933.

The Proceedings then terminated.

JOURNAL

ROYAL MICROSCOPICAL SOCIETY.

TRANSACTIONS OF THE SOCIETY.

VII.—MEIOSIS IN ASYNAPTIC DWARF OATS AND WHEAT.   576.36.

C. Leonard Huskins and E. Marie Hearne, McGill University, Montreal.

FOUR PLATES.

Introduction.

The 40-Chromosome " B " Series fatuoid oat dwarfs used in this study are similar to those already described in part by Goulden (1926), Huskins (1927), and Nishiyama (1931). At the heterotypic metaphase most of the forty chromosomes are usually univalent, although they comprise twenty pairs of homologues. The resultant irregular divisions lead to the production of non-functional pollen and only a very small proportion of functional mega-spores. The speltoid dwarfs are analogous mutant forms of wheat. The earlier studies mentioned have not embraced the important prophase stages. The present study emphasizes them. Where there is repetition,·the present observations agree with the earlier ones.

The chromosome complement of these dwarfs differs from the normal in lacking a pair of " C " chromosomes (Huskins, 1927, 1928). Kihara (1925) obtained two 40-chromosome dwarf wheat plants, of which one lacked a pair of " f " chromosomes and the other a pair of " g " chromosomes. These dwarfs, however, form twenty bivalents in meiosis (Nishiyama, 1928, and Wakakuwa, 1929). It is therefore postulated that the " C " chromosomes carry factors essential for normal chromosome pairing. (Nishiyama (1931), whose paper appeared while the present study was in progress, has also suggested this as a possibility.)

Newton and Pellew (1929) found plants of *Primula kewensis* lacking one pair of chromosomes to be asynaptic. Genetically determined asynapsis has been described by Beadle (1930) in maize, Blakeslee (1928) in Datura, Clausen, J., (1930) in *Viola orphanidis*, Clausen, R. E., (1931) in Nicotiana, and Huskins and Smith (1933) in Sorghum. Asynapsis due to high temperatures has been described by Takagi (1928) in *Lychnis Sieboldii*, by Heilborn (1930) in apples, and in Triticum-Ægilops hybrids by Katayama (1931). Sax (1931) has obtained asynapsis in *Rhœo discolor* through low temperatures. Other cases of genetic factors affecting chromosome size, structure, or behaviour have been described by Lesley and Frost (1927), Gowen (1928), Darlington (1929), Beadle (1931), and Philp and Huskins (1931).

This study was undertaken primarily to determine the cause of the previously described lack of pairing at metaphase. Recent cytological work, especially of Darlington (1932 and earlier), has emphasized the limitations of metaphase observations as an indication of earlier prophase conditions. The metaphase lack of pairing might, for instance, have been found to be due either to failure of synapsis, failure to form chiasmata, or to premature separation after normal pairing. At the same time it was anticipated that analysis of the prophase conditions in this material would provide evidence bearing on the mechanism of meiosis in general and on the significance of chiasmata in chromosome pairing. The observations will be discussed from these viewpoints.

The irregularities of meiosis in these dwarf plants are similar in several respects to the irregularities of mitosis in certain tumours, and their possible bearing on this problem will also be considered. Ludford (1930a) has recently reviewed the somatic cell mutation theory of cancer, so that repetition here is unnecessary.

Normal *Avena sativa* and *Triticum vulgare* material has, of course, been studied for comparison at all stages of meiosis, though only a few stages in the normals have been illustrated. Typical parasynapsis was found, and the authors are therefore in sharp disagreement with Melburn (1929) who described telosynapsis in rye and wheat-rye hybrids.

Material and Methods.

The observations have been confined almost entirely to pollen mother-cells. A few embryosac mother-cells were examined and found to be similar in meiotic behaviour. Material was prepared either by McClintock's (1929) permanent aceto-carmine smear method or by the paraffin section method. The paraffin material was fixed by Kihara's method—Carnoy 3 : 2 : 1 mixture for one minute followed by medium Flemming—and stained with Newton's iodine gentian-violet. Drawings were made with the aid of a camera lucida using a Zeiss 1·5 mm., 1·3 N.A. apochromatic objective and 10 × or 20 × compensating oculars. The normal material examined included Victory, Siberian, Aurora, and Kanota oats and Swedish Iron wheat. Fatuoids and
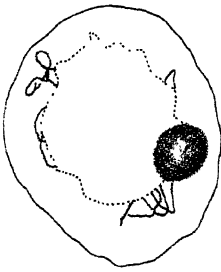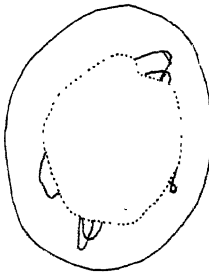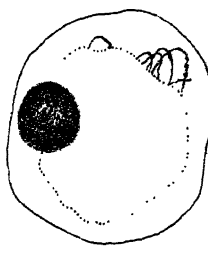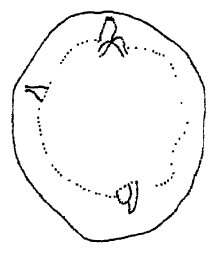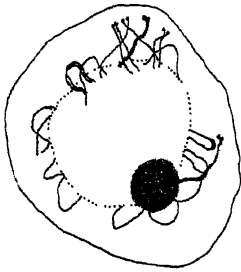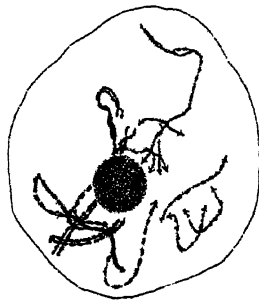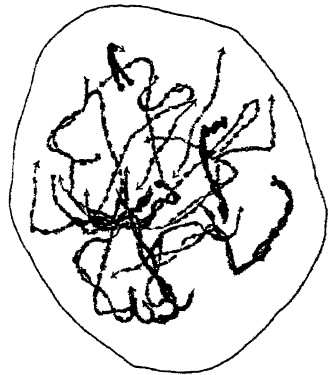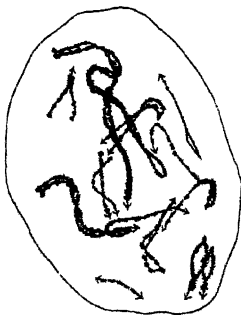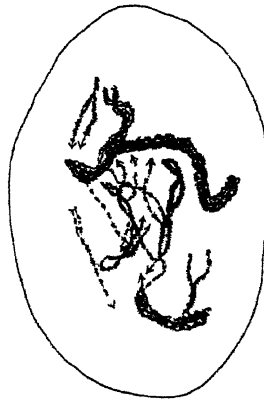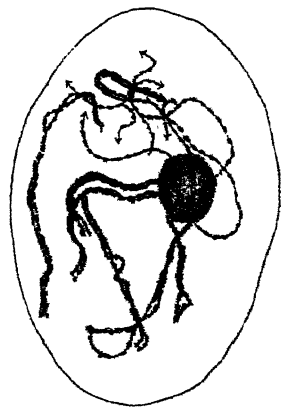
speltoids of " Series A," having the normal chromosome number, were also examined and found to be normal in the features here specially considered.

The figures of prophase stages before diakinesis are all of optical sections only. For such material having large and numerous chromosomes, this method seems to illustrate essential features better than attempts to show the whole nucleus. Arrow-heads indicate that threads are passing out of the focal plane and are not terminated. In leptotene and early zygotene figures the main mass of the nucleus is represented merely in outline, since it is on projecting threads that observations can be made with the greatest certainty.

Observations.

Since much more material was available of dwarf oats than of dwarf wheats, the former will be described in detail and the latter then considered comparatively.

Leptotene.—Evidence of a precocious splitting of the leptotene threads was observed in several cases (pl. I, figs. 1–3). Irregularities in the degree of contraction were also noticeable, even at this early stage. In the nuclei of normal plants the threads were more evenly distributed and less matted before the onset of synapsis ; far fewer threads projected from the border of the main mass, and none were observed to be split. A number of free ends were always visible, indicating that there is no " continuous spireme."

Zygotene.—In a number of cases clear evidence was found of pairing beginning between terminal chromomeres, as shown in pl. I, fig. 4, from a dwarf, and fig. 5 from a normal oat. This agrees with the observations of Belling (1931) on Liliaceous plants and of Gelei (1921) on Dendrocœlum, but in this material we cannot be certain that the onset of pairing is exclusively terminal. There is considerable loosening of the " spireme knot " with the onset of zygotene. Great variation in the degree .of contraction of the chromosomes was observed at all stages after the beginning of zygotene in the dwarfs. Unpaired threads, most of which are partially split, are least contracted (pl. I, figs. 6, 7, and 8). Threads which are paired along part of their length are frequently split in unpaired regions (pl. I, fig. 9). Irregular looping, due to paired homologues being differentially contracted (pl. I, fig. 10, and pl. II, fig. 11), was frequently noted.

Pachytene.—In all the many cells of dwarf oats examined no case of close, even pachytene pairing was observed. The most nearly normal cell found is illustrated in pl. II, fig. 12, which may be compared with fig. 13 from a typical pollen mother-cell of a normal plant. A confused, irregularly

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contracted zygotene-pachytene-diakinesis condition, such as shown in pl. I, fig. 8, is most common.

Early Diakinesis.—A large number of univalents were always found at early diakinesis. That shown in pl. II, fig. 14, is typical. Early diakinesis in a normal oat is shown in pl. II, fig. 15.

Late Diakinesis.—At late diakinesis in the dwarfs most of the chromosomes are univalent (pl. III, figs. 19 and 20). The number of bivalents probably corresponds to that at metaphase, on which data are given in Table I. At this stage the degree of contraction is comparatively uniform in most cells. In some cells the chromosomes were found to be disintegrating.

Metaphase.—Varying numbers of bivalents from 0–14 and occasional multivalents, as shown in Table I, were found in dwarfs at the metaphase. Typical metaphase plates are shown in pl. III, figs. 21 and 22. Occasional cells were found with eighty chromosomes, as illustrated in pl. III, fig. 23.

TABLE I.

CHROMOSOME ASSOCIATIONS AT THE HETEROTYPIC METAPHASE IN 40-CHROMOSOME DWARF, FATUOID OATS—PERMANENT ACETO-CARMINE PREPARATIONS.

Plant No.	I's.	II's.	III's.	IV's.	Plant No.	I's.	II's.	III's.	IV's.
30–112 2/6a	29	4	1	—	30–113 2/1	28	6	—	—
	20	10	—	—		26	7	—	—
	16	10	—	1		28	6	—	—
	32	4	—	—	30–118 1/7	40	—	—	—
	16	10	—	1		20	10	—	—
	30	5	—	—	30–119 2/1	36	2	—	—
	28	4	—	1		66	7	—	—
30–112 2/6b	32	4	—	—		22	9	—	—
	16	10	—	1	30–123 2/1a	29	2	1	1
	30	5	—	—		36	2	—	—
	28	4	—	1		32	4	—	—
	12	14	—	—		28	6	—	—
30–113 2/1	26	7	—	—		34	3	—	—
	26	5	—	1		28	6	—	—
	28	4	—	1		40	—	—	—
	32	4	—	—		38	1	—	—
	32	4	—	—		32	4	—	—
	32	4	—	—	30–123 2/1b	34	3	—	—
	26	7	—	—		34	3	—	—
	26	7	—	—		34	3	—	—
	18	11	—	—		32	4	—	—
	34	3	—	—		32	4	—	—
	18	11	—	—	30–123 2/5	30	5	—	—
	30	5	—	—		—	—	—	—

Anaphase.—Great irregularity was found in most anaphases, and fragmentation of chromosomes appears to be frequent (pl. III, fig. 24). A very few comparatively normal anaphases, such as that in pl. IV, fig. 25, were seen.

Telophase.—A few telophases were found in which all the chromosomes were included in the daughter nuclei. In the great majority of cells, however, a number of chromosomes were still lagging on the spindle after the nuclear membrane had re-formed.
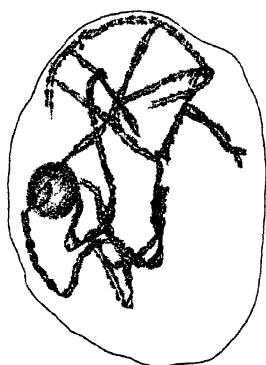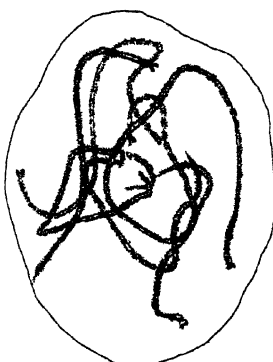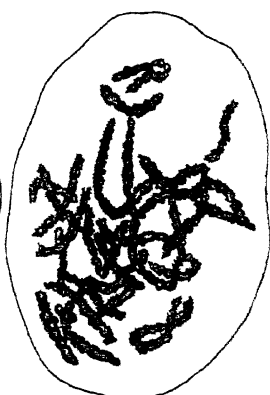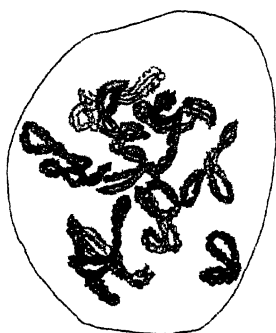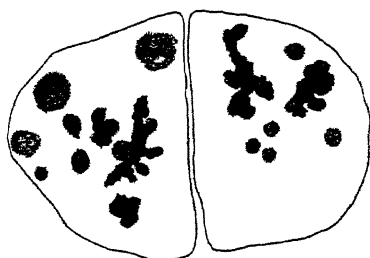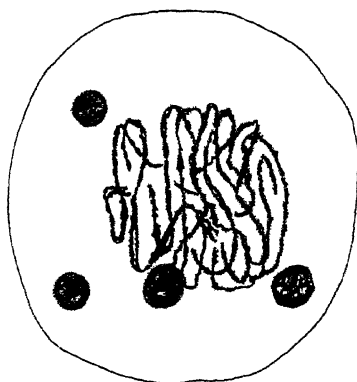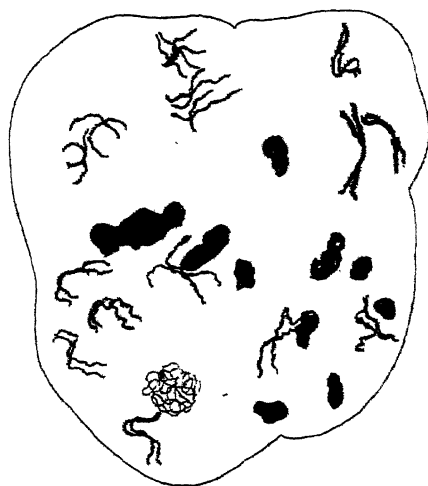
Interkinesis.—Varying numbers of micronuclei are present in most of the pollen dyads, as shown in pl. II, figs. 16 and 17. The homœotypic prophase is shown in the macronucleus of the former. In the majority of cases there are two large nuclei and several micronuclei.

Homœotypic Division.—Irregularities are very numerous, and range from the extreme condition shown in pl. II, fig. 18, which follows failure of cytokinesis after the heterotypic division, to almost normal divisions in which only a few chromosomes or micronuclei lie disintegrating in the cytoplasm while the remainder are grouped in four large nuclei. Commonly found conditions are illustrated in pl. IV, figs. 26, 27, and 28. These irregularities lead to the production of irregular sized, sterile pollen, and it is evident that a breakdown and disintegration of the nucleus may occur at any stage after diakinesis.

Dwarf Speltoid Wheats.

Only a limited amount of cytological material was available from 40-chromosome dwarf speltoid wheats. In these a few metaphases were found which were practically normal, having 20_{II}, as shown in pl. IV, fig. 29. Two of the bivalents in this cell, however, are more loosely paired than is usual in normal wheat or oat varieties at early metaphase. Other metaphases showed nearly as many irregularities, including fragmentation (pl. IV, fig. 30), as the dwarf oats. One quite regular anaphase was found, but most were very irregular.

Discussion.

Because there are different 40-chromosome dwarf wheats which regularly form 20_{II}, it was assumed that the " C " chromosomes missing in these asynaptic 40-chromosome dwarf fatuoid oats and speltoid wheats must carry a factor or factors necessary for normal chromosome pairing and meiosis. Additional evidence favouring this assumption has recently been obtained by John M. Armstrong in this laboratory, who finds that an aberrant strain of awnless speltoids which apparently differs from the awned strain in which it arose through having a small segment of chromosome duplicated, also differs in the chiasma frequency of its chromosome complement as a whole. While this does not yet locate a factor for metaphase chiasma frequency quite definitely on the " C " chromosome, it does locate it on one of the three pairs of " homœologous " chromosomes concerned in the determination of speltoid *versus* normal characteristics. Further, counts of metaphase chiasma frequency were made on various 41-chromosome heterozygous fatuoids and speltoids lacking one " C " chromosome, and it was found to range from 41 to 44 for the twenty bivalents, as compared with about 47 per twenty bivalents in normal 42-chromosome plants. Further studies of this material are in progress to determine whether lower initial frequency or accelerated terminalization is involved.

It is now clear that the irregularities of the 40-chromosome dwarfs begin very early in meiosis, if not before its onset, and that the lack of metaphase pairing is the result of true asynapsis, not of premature terminalization. It seems very probable that the conditions found in the 40-chromosome and 41-chromosome plants have a common cause, but that the factor for normal meiosis is almost completely dominant, so that in the absence of only one " C " chromosome meiosis is so nearly normal that it can be distinguished only by the lowered chiasma frequency at metaphase.

It was hoped that study of these asynaptic plants might provide significant evidence on the mechanism of meiosis. Darlington (1931) has advanced a very stimulating hypothesis to correlate mitosis and meiosis and has given a definite formulation to the chiasma theory of metaphase pairing. Though these hypotheses are independent, they can perhaps briefly be summarized together as follows : A universal " mitotic affinity " of chromosome threads in pairs at a certain stage of contraction is postulated. Meiosis differs from mitosis in that at the earliest stages at which the chromosomes can clearly be traced they are single, whereas in mitosis they are already double. Meiosis is therefore assumed to be initiated by a premature prophase contraction which precedes chromosome splitting and therefore causes the " mitotic affinity " to be satisfied by the approximation of whole chromosomes instead of split halves. Splitting occurs during pachytene with interchanges (crossing-over) between paired chromosomes and consequent formation of chiasmata. From diplotene on there is a repulsion within the " tetrads " between pairs of pairs, but the chromosomes are held together until anaphase by the chiasmata.

The present observations strongly support the hypothesis that metaphase pairing depends upon the maintenance of chiasmata formed during pachytene-diplotene. The occurrence of multivalents, despite the low mean degree of pairing, supports the hypothesis that there is competition in zygotene pairing in polyploids (cf. Darlington (1931) and Huskins (1932)). In a general sense the observations are considered strongly to support Darlington's mitosis-meiosis hypothesis. In detail, however, they support rather Huskins' (1932) modifications of it.* Evidence has been adduced by Huskins which indicates that it is the splitting which is primary and the contraction secondary, and that meiosis is more probably initiated by retardation or inhibition of a split in the chromonemata during the last premeiotic division than by precocious contraction in the prophase. The occurrence of split threads at a very early leptotene stage in the dwarfs supports this conception. On the other hand, there is no doubt that the differential contraction affects synapsis, and it is clearly very difficult to delimit the effects of splitting from those of contraction. The fact that paired chromosomes are more contracted than unpaired ones seems to indicate that pairing itself produces or favours contraction. The evidence in this respect is similar to that from Mecostethus,

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* See *Nature*, July 8th, 1933, p. 62, for discussion of further evidence, obtained since the above was prepared, on the mechanism of mitosis and meiosis.

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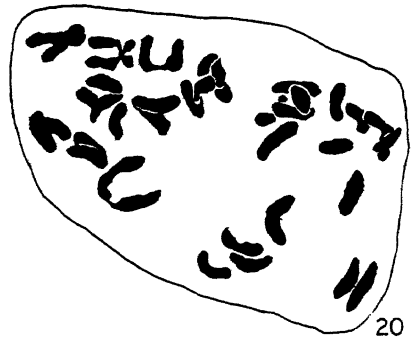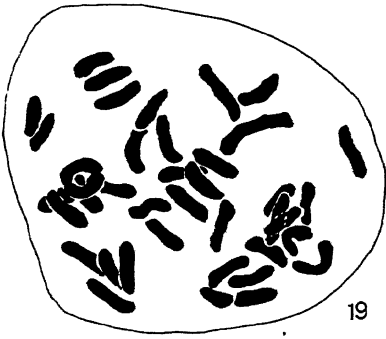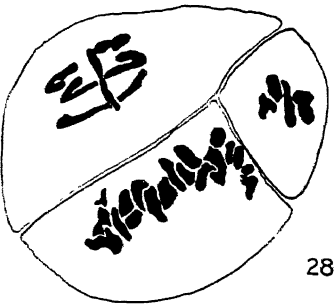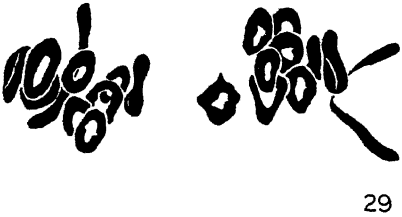
in which McClung (1927) showed that the ring bivalent is more contracted than the remainder, which are paired only end to end. The tendency towards equalization of contraction before metaphase is also taken to indicate that contraction is secondary to splitting and pairing. On the other hand, Wilson (1905) has shown that the ideochromosomes of the Hemiptera, which pair transitorily only just before metaphase, are contracted before the chromosomes which pair in the usual manner, and McClung (1927) has also shown that unequal pairs and the unpaired X-chromosome contract before the paired chromosomes in the Orthoptera.

The similarity of the irregularities in splitting and contraction to those of certain tumours appears to be significant. If either Darlington's hypothesis correlating meiosis and mitosis or Huskins' modification of it approach a true conception of their relationship, then clearly any factor, environmental or genetic, which affects contraction or splitting may cause chromosome pairing in somatic cells and consequent haploidy or aneuploidy. Huskins (1932) cites observations of pairing in nucellar cells of Matthiola, and, further, the occurrence of plasmodial-like masses of cells in the anthers of aneuploid wheat, triploid maize (McClintock) and haploid wheat (Gaines, and Aase).

In transplantable carcinomata and sarcomata Ludford (1930*b*) found great variation in chromosome numbers, in degree of contraction, and in the splitting of the chromosomes, as have many other investigators. In another paper (1930*a*), which obviates the necessity for extensive discussion of the problem here, Ludford reviews the somatic cell mutation theory of cancer, and discusses the difficulties in the way of determining whether the variations in chromosome number are the cause of cancer, or are themselves " the expression of a disorganization of mitosis due to some so far unknown disturbance of cell function." The existence of genes specifically affecting chromosome structure, pairing, and division, now fully demonstrated by Lesley and Frost (1927), Beadle (1930, 1931), Philp and Huskins (1931), and others, and the evidence from the present case of the effects of the loss of whole chromosomes seems to provide strong *a priori* evidence that both gene mutations and chromosome aberrations are among the causes of cancer.

Summary.

Asynapsis is produced in certain dwarf wheats and oats through the loss of a specific pair of chromosomes.

The lack of pairing is correlated with premature splitting of the chromosome threads and irregular contraction, of which the former is probably primary.

The observations are discussed with respect to ·hypotheses correlating meiosis and mitosis.

The possible bearing of the irregularities in splitting and contraction on the significance of similar irregularities in mammalian tumours is also discussed.

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DESCRIPTION OF PLATES.

PLATES I and II.

All illustrations of optical sections from uncut cells of 16μ paraffin sections ; drawn at $4080\times$ and reduced to 3/5.

Figs. 5, 13, and 15 from normal *Avena sativa*, the remainder from 40-chromosome dwarf fatuoid oats.

Figs. 1–3, leptotene ; 4–6, zygotene ; 7–10, pachytene-diplotene ; 11–13, pachytene ; 14 and 15, early diakinesis ; 16–18, interkinesis. The macronucleus in fig. 16 is at the homœotypic prophase stage. Failure of cytokinesis has occurred in fig. 18. See text for further description.

PLATES III and IV.

All illustrations of entire cells, from permanent aceto-carmine preparations ; drawn at $1900\times$ and reduced to 3/5.

Figs. 19–28 from 40-chromosome dwarf fatuoid oats ; figs. 29 and 30 from 40-chromosome dwarf speltoid wheats.

Figs. 19 and 20, diakinesis ; 21–23, metaphase, the latter a tetraploid cell ; 24 and 25, anaphases, the former irregular and showing chromosome fragmentation, the latter nearly normal ; 26–28, homœotypic divisions ; 29 and 30, metaphases in dwarf speltoids, the former nearly normal, the latter irregular. See text for further description.

593. 15.   VIII.—A NEW GENUS OF ROTIFERS (*DORRIA*).

With Observations on *Cephalodella crassipes* (Lord):

Cephalodella crassipes (Lord) and *Dorria dalecarlica.*   Gen.n., Sp.n.

By FRANK J. MYERS, F.R.M.S.

(*Read May 17th, 1933.*)

ONE PLATE.

IN 1903 Mr. J. E. Lord, an English microscopist, described the rotifer *Diaschiza crassipes*=*Cephalodella crassipes*, from a single specimen found among confervoid algæ growing, here and there, on the dripping face of a small cascade, situated near his home.   Until 1926 this rotifer had not been refound.   During the month of May, in that year, it was collected in abundance among confervoid algæ on the shelving face of a small cascade near Johnstown, New York.   As Lord's description is somewhat fragmentary, I take this opportunity to describe the rotifer in greater detail.

Cephalodella crassipes (Lord).

The body is very stout, cylindrical, gibbous dorsally, and nearly straight or slightly concave ventrally.   The head is rather small, deflexed and oblique anteriorly.   It is sharply set off from the abdomen by a neck constriction.   The integument is quite flexible, but the lateral clefts are well marked and flaring posteriorly.   The toes are short and laterally compressed. From a broad base, they decrease abruptly and end in blunt, claw-like tips.

The lateral antennæ are minute and situated somewhat higher than is usual in the genus.   The dorsal antenna is fairly large and consists of a pencil of short setæ surmounting a papillose prominence.

The corona is oblique.   The circumapical band is composed of long, marginal cilia enclosing the small apical area.   The buccal plate is sparsely ciliated.   The mouth is situated slightly below the centre of the corona, and the lips do not project in the form of a beak.

The mastax is of the usual modified virgate form peculiar to the genus. The trophi are relatively small.   The rami are imperfectly developed, the lateral portions forming a thin, lamellar, dome-like structure that helps to support the walls of the mastax during pumping action.   The inner ventral edges of the rami are, near the apex, provided with a comb-like denticular lamella having ten or twelve long, slender, appressed teeth.   The manubria

are stouter than usual and are bent at an abrupt, obtuse angle near mid-length. The unci have a single, weak, slender tooth.

The œsophagus is long and sinuate. The stomach is usually crowded with the conferva the animal feeds on, and is confluent with the clear intestine. The gastric glands are small and reniform. The foot glands are long and stout.

The ganglion is large and saccate. The eyespot is situated at the posterior end of the ganglion somewhat ventrally placed. No retrocerebral organ is present.

Total length, 210–250µ ; toes, 25–30µ.

Habitat.—Among confervoid algæ in rocky stream associations.

The foot and toes of this species, as figured by Lord, are retracted and do not convey an accurate idea of the normal posterior portion of the body. When the rotifer swims—and it does swim very actively at times—the foot and toes are directed backward in a line with the body axis.

Cephalodella crassipes is evidently a segregate species. There seems to be a growing rotatorian fauna composed of species, whose ethology is very special, distributed throughout the world where ecological conditions are exactly similar. The best known of these rotifers probably is *Epiphanes senta* (Müller). *Dicranophorus hudsoni* (Glascott) is also a segregate species (de Beauchamp, 1929).

There is no doubt that *Cephalodella crassipes, Cephalodella xenica* (Harring & Myers, *loc. cit.,* p. 492), and *Cephalodella eupoda* (Harring & Myers, *loc. cit.,* p. 512) are the same species. *Cephalodella eupoda* was collected in Four Mile Run, Washington, District of Columbia ; a rocky stream with submerged moss and algæ-covered rocks. *Cephalodella xenica* was collected in the Huron River, Michigan. Besides their striking resemblance, it is a significant fact that the above rotifers are fluviatile and were collected among confervoid algæ in lotic associations.

Order : PLOIMA

Family : Notommatidæ.

Subfamily : Notommatinæ.

Dorria Gen.n.

Body illoricate, fusiform, cylindrical. Foot with two joints. Toes, two.

Corona an oblique, oblong disc with well-developed circumapical band differentiated into two lateral tufts of longer cilia especially adapted for locomotion. Apical plate enclosed by the marginal ciliation. Buccal field evenly ciliated. Mastax modified virgate type. Epipharynx present.

Retrocerebral sac and subcerebral glands present. There is no eyespot.

Dorria dalecarlica Sp.n.

The body is elongate, cylindrical, and rather slender. The integument is thin, transparent, and flexible.

The head is long and separated from the abdomen by a well-marked constriction. The abdomen is about twice the length of the head and gradually tapers, dorsally, to a small tail. The foot is long, stout, and two-jointed. The toes are short and broad in lateral view ; they increase slightly in depth for about one-half their length, then decrease suddenly to short tips, squarely truncate at the posterior end. The toes are compressed in dorsal view ; the lateral edges undulate ; the inner edges outcurved.

The corona is sub-prone and is equal to about two-thirds that of the head, in length. There is a nude apical area and also a small cuticular fold, both enclosed by the marginal ciliation. The buccal field is large and evenly clothed with short cilia. The circumapical band is differentiated, laterally, into two tufts of longer, locomotor cilia resembling auricles.

The mastax is virgate, but modified, having become adapted for prehension through the mouth opening. This type of mastax, being a combination of two types (virgate and forcipate), is a secondary readaptation to another method of feeding : the seizure of prey. The rami are lyrate, and have fairly prominent alulæ for the attachment of the abductor muscles ; laterally, they are expanded into somewhat asymmetrical lamellæ. Near mid-length the rami are bent at right angles, and this section is coarsely denticulate on the inner edge. The dorsal ends of the rami form two powerful, bifid teeth. The fulcrum is lamellar, moderately long, expanded at the base of the rami and nearly parallel-sided posteriorly. The unci have a single powerful tooth, somewhat clubbed at the tip, followed by a much weaker accessory tooth. The manubria are long and slender, the basal plate being small and subsquare. The epipharynx consists of two square plates, the inner edges of which are roughly denticulate. The hypopharynx is large and almost fills the cavity of the mastax.

The stomach and intestine are not distinctly separated. The gastric glands are large and oval. The ovary is normal and the bladder is absent. The foot glands, as might be expected in a species that frequently has to cling tenaciously in order to maintain its hold, are very long and stout, projecting for some distance into the body cavity.

The retrocerebral sac is small ; its contents are rendered opaque by the presence of densely crowded bacteroids. The duct is well marked and can be easily traced to the two outlets on the corona. There are a pair of sub-cerebral glands nearly as long as the retrocerebral sac. There is no eyespot.

Total length, 180–200μ ; toes, 15–20μ.

Habitat.—Mountain brooks among submerged moss.

Dorria dalecarlica was originally found among *Fontinalis dalecarlica* in Duck Brook, Mount Desert Island, Maine. Later, in the same year, among the leaves of aquatic moss in a mountain brook near Johnstown, New York.

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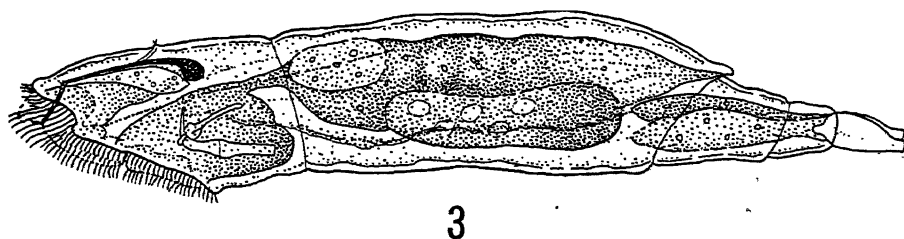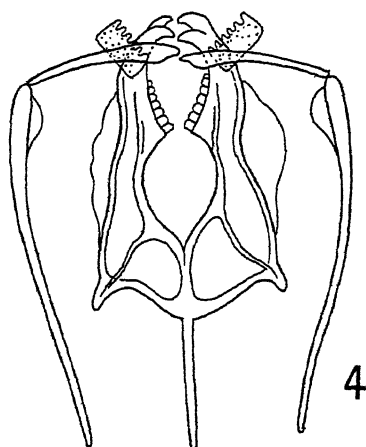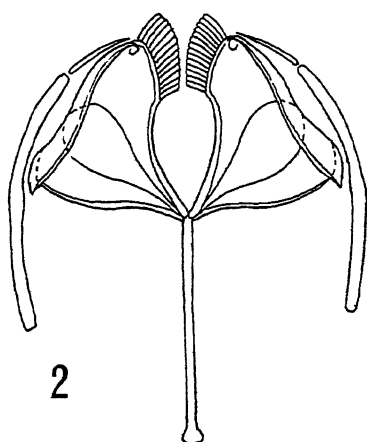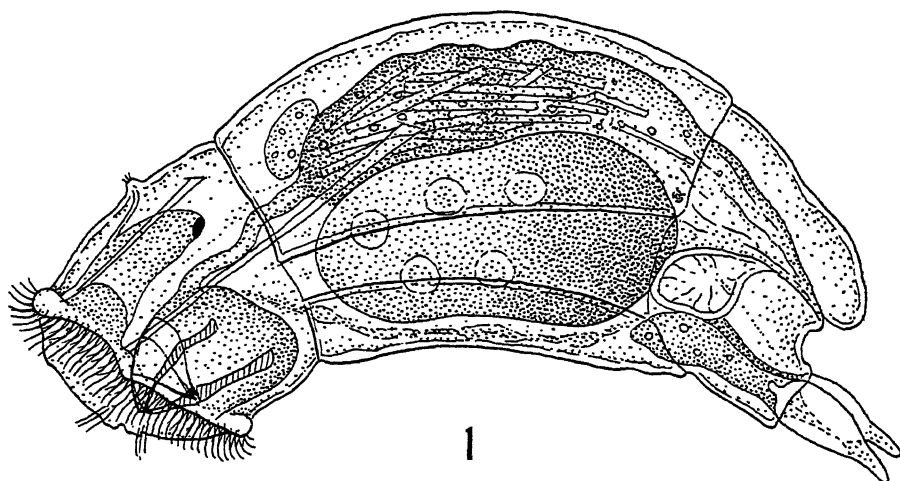
It bears a certain resemblance to *Dicranophorus* in the general shape of the body and the ciliation of the corona. It suggests *Notommata* by the presence of a retrocerebral sac together with subcerebral glands ; also certain elements of the trophi. Finally, the mastax comes fairly close to that of *Enteroplea lacustris* (Ehrenberg), thus partaking of the characters of three genera.

As Rousselet aptly said : " In the classification of the rotifers one always meets with the difficulty that no sooner have some genera been well separated than a new rotifer is found having some of the characters of two or three distinct genera." This seems to be as true to-day as it was then, in 1890.

While it is regrettable to add another monotypic genus to a class already encumbered with them, there seems to be no other alternative, as keeping this rotifer attached to another group would be merely obscuring the fact of its divergence.

Dorria dalecarlica is evidently a segregate species, having been found only in the lentic parts of mountain brooks where submerged moss clings to the surface of the rocks. Wherever these ecological conditions are present, this rotifer is apt to be found. It has been collected repeatedly in similar, widely separated associations.

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DESCRIPTION OF PLATE.

Fig. 1.—*Cephalodella crassipes* (Lord).
Fig. 2.—*Cephalodella crassipes*, trophi, ventral view.
Fig. 3.—*Dorria dalecarlica* Myers.
Fig. 4.—*Dorria dalecarlica*, trophi, oblique frontal view.

591.389.   IX.—ON THE NATURE OF THE "YOLK-NUCLEUS" OF
SPIDERS.

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(*Read May 17th*, 1933.)

Two Plates.

Introduction.

The yolk-nucleus of spiders has been a subject for research since 1845. Its
nature in such spiders as *Pholcus* and *Crossopriza* has been fully worked out,
but in spiders like *Tegenaria* it still continues to be controversial.

Van Bambeke (1898) described a pallial layer or mantle layer (Wilson,
1925) in the form of an almost circumnuclear ring in the young oocytes of
Pholcus phalangioides. This ring consists of fine granules and minute
circular bodies. With the growth of the oocyte the pallial substance
fragments throughout the oocyte, and gives rise to fatty deutoplasm which
is blackened intensely by osmic acid and is decolorized by turpentine or
xylol. Albuminous yolk arises *de novo* in the cytoplasm. The granules and
the circular bodies are figured quite distinctly, but no mention is made of
them in the text. Nath (1928), working on a closely allied species, *Crosso-
priza lyoni*, has described a similar ring in his material, and has shown that
the fine granules and the circular bodies are the mitochondria and the Golgi
elements respectively. He has further shown that the Golgi elements only,
and not the whole pallial substance, give rise to the fatty yolk, and he has
also been able to confirm Van Bambeke's statement that the albuminous
yolk arises independently in the cytoplasm.

It is thus clear that the yolk-nucleus in such spiders as *Pholcus* and
Crossopriza represents the Golgi and mitochondrial material which, as has
been shown by recent research, usually exists in the form of juxta-nuclear
or circumnuclear mass in the youngest oocytes. But the well-known yolk-
nucleus of *Tegenaria*, first described by Wittich as early as 1845 and subse-
quently by other writers, has so far baffled all attempts to elucidate its
nature. According to Wilson (1925) Wittich found the yolk-nucleus as a
rounded body lying near the germinal vesicle, later enlarging markedly and
acquiring a concentric fibrillated or laminated structure. In 1850 Carus
gave it the name of " Dotterkern." The most recent work on this material
is that of Weiner (1925). According to this author the yolk-nucleus of

Tegenaria makes its appearance in the earliest growth period, and consists of a specific substance elaborated by the Golgi elements. This substance forms the base, and may contain particles of Golgi material, mitochondrial granules, and centrosome. It must, however, be clearly understood that in *Tegenaria* Weiner did not discover any centrosome in the yolk-nucleus. To use his own words about the yolk-nucleus :—" C'est un amas de substance spécifique, élaborée par l'appareil Golgi ; cette base peut etre additionnée de mitochondries, de particules de l'appareil Golgi, elle peut enfermer le centrosome—tous ces éléments n'étant, néanmions, pas caractéristiques et ne jouant qu'un rôle secondaire dans la formation du noyau vitellin."

From the above account of the yolk-nucleus of *Tegenaria* it is evident that it is not quite comparable with the yolk-nucleus of *Pholcus* and *Crossopriza*, in as much as no " substance spécifique " has been found in the latter. Besides, it does not represent the Golgi and the mitochondrial material of the oogonial cells, which is usually arranged in the juxta-nuclear or circum-nuclear fashion, but is a structure which appears early during the growth period. According to both Wittich and Weiner, it grows in size and remains intact throughout oogenesis, whereas the usual aggregation of mitochondria and Golgi material of oogonial cells undergoes progressive disintegration. Wittich has even shown that in some spiders it remains nearly unchanged in the embryo throughout nearly the whole of its development (Wilson, 1925).

In view of the above it was considered desirable to investigate this structure. *Tegenaria* being not available in this part of the country, work was undertaken on the cosmopolitan spider, *Plexippus paykulli*, whose yolk-nucleus is of the same type as that of *Tegenaria*.

Material and Technique.

Females of *Plexippus paykulli* are very common in houses and gardens in Lahore during the months of April to October, but they become very scarce in winter.

In addition to the usual laboratory methods (Kolatchew, Da Fano, and Champy iron-hæmatoxylin) for the demonstration of the mitochondria and the Golgi elements, we have studied fresh oocytes of all stages. We have been very much impressed with the remarkable facility with which the mitochondria, the Golgi elements, and the yolk-nucleus can be observed *intra vitam*. The yolk-nucleus stands out in the living oocyte with such startling clarity that our microphotographs reveal even the components of this structure. Fresh cover-slip preparations osmicated for a few minutes were also studied. Bouin's fluid was used as a control.

Observations.

· The ovary is a hollow sac. Its lumen is lined by small primordial germ-cells from which the nurse-cells, the oogonia, and the oocytes are differen-

tiated. These latter appear like bunches of grapes lying on the surface of the ovary.

In the oogonium the mitochondria exist in the form of minute granules aggregated in a juxta-nuclear position. The Golgi elements are embedded in this mass. In Champy unstained preparations (fig. 1) studied immediately after mounting, the Golgi elements appear as dull black spheres which gradually tend to decolorize in Canada balsam. The action of the Canada balsam is accelerated if the slides are dried in an oven. In such preparations the mitochondria appear as yellowish granules. In Champy preparations stained with iron-hæmatoxylin the Golgi elements stain a dark blue colour and the mitochondrial granules, which are smaller, are bluish.

As soon as the growth begins the juxta-nuclear mass of mitochondria and Golgi elements begins to spread out in the cytoplasm. In regions of close aggregations both these cell elements can be easily observed *intra vitam* (fig. 2). The mitochondria appear as greyish granules and the Golgi elements as more refractile and perfectly spherical bodies. Both these cell elements are gradually distributed throughout the cytoplasm. Throughout oogenesis the mitochondria remain as small granules, but some of the Golgi spheres grow slightly in size.

Immediately after the mitochondria and the Golgi elements have uniformly dispersed in the cytoplasm and the nucleus has become slightly eccentric the yolk-nucleus puts in its appearance. This structure has never been observed by us in oocytes measuring 0·08 mm. or less. In living oocytes studied in a drop of normal saline (figs. 3, 4, and 7) it appears as a spherical capsule which, of all the cell-components, stands out most prominently in the cytoplasm. The cortex of the capsule is made up of concentrically arranged threads, and the medullary region contains darkgreyish, refractile, spherical bodies. In some yolk-nuclei these bodies may be aggregated in the central region of the medulla, so that a clear empty space appears between the two regions (fig. 7). Granules similar to those present in the medulla exist amongst the cortical fibres also, as is clearly revealed by fixed preparations (*vide infra*). The yolk-nucleus is a structure of remarkable solidity, so much so that it retains its spherical form even after the egg is ruptured. Further, it may drop out in the process of sectioncutting, leaving an empty space in the cytoplasm.

When 2 per cent. osmic acid is run under the cover-slip the medullary granules of the yolk-nucleus become darker in a few minutes and stand out more prominently (figs. 8, 8a). But there is not any appreciable change in the visibility of the cortical threads.

The medulla and the cortex appear as two sharply differentiated regions in the microphotographs of living oocytes, and even the granules of the medulla stand out prominently.

It has been very easy to ascertain the nature of the granules of the medullary region, but we have had some difficulty about the cortical fibres. The medullary granules go jet-black like the typical Golgi apparatus in such

preparations as Kolatchew and Da Fano (figs. 9 and 10). In Champy unstained preparations studied immediately after mounting they appear as dull black spheres. When Champy is followed by iron-hæmatoxylin they go dark blue (fig. 5). In all these preparations it will be observed that smaller Golgi granules exist amongst the cortical fibres. The Golgi granules of the yolk-nucleus react exactly like the Golgi elements distributed in the general cytoplasm.

It has been already mentioned that we have had some difficulty with regard to the nature of cortical fibres. But after a very careful consideration of the available evidence we are inclined to interpret them as mitochondria. From the very beginning we suspected that the fibres may be the result of very close alignment of mitochondrial granules, and our suspicions have been largely confirmed by the study of such typical mitochondrial preparations as Champy iron-hæmatoxylin (fig. 5). Here in place of cortical fibres we observe very closely aggregated small bluish granules. Similar granules are found in the medullary region.

In Bouin-hæmatoxylin preparations the Golgi and the mitochondrial elements of the yolk-nucleus persist in spite of the acetic acid, although those of the general cytoplasm are completely washed out (fig. 6). We need hardly mention that their persistence in the region of the yolk-nucleus is undoubtedly due to their very close aggregation.

There are a number of nurse-cells associated with each oocyte (figs. 2, 7, and 11). Each cell contains a number of Golgi spheres, but no trace of mitochondrial material can be discovered in them.

The albuminous yolk granules appear for the first time at the periphery of the oocyte (figs. 8 and 9). They arise *de novo* in the cytoplasm without any visible association either with the mitochondria or the Golgi elements. Gradually they grow in size and invade the interior of the cell (fig. 10). In more advanced oocytes the yolk granules become vacuolated.

Discussion.

(a) *The Yolk-Nucleus.*—The yolk-nucleus in such spiders as *Tegenaria* is certainly present. As we have shown in *Plexippus*, it stands out with amazing clearness in the living oocytes as a shell-like structure which can be easily microphotographed. It retains its identity even after the egg is crushed. In *Plexippus* it consists of cortical, concentrically arranged fibrils which have been interpreted by us as aligned, closely aggregated mitochondrial granules. Mitochondrial granules are present in the medulla also, but they are generally masked by the more prominent and bigger Golgi spheres. These latter are distributed also amongst the cortical fibres. The yolk-nucleus appears for the first time in oocytes bigger than 0·08 mm. and must not be confused with the primary juxta-nuclear mass of mitochondria and Golgi elements of the oogonial cells. It gradually grows in

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size and has been found intact by us in all subsequent stages we have examined.

In *Tegenaria* also, according to Weiner, the yolk-nucleus appears during the earliest stages of growth period and later consists of cortical fibres and Golgi elements. Weiner has interpreted these fibres as the "substance specifique," forming the base of the yolk-nucleus. But a careful study of Weiner's description suggests that his specific substance may be interpreted in a different way. Weiner describes the first appearance of the yolk-nucleus as follows :

" . . . , dans des ovules un peu plus âgées un petit amas das la partie la plus large de la zone plasmatique ; dans cet amas la plasme devient plus sombre ; enfin entre ces particules de l'appareil Golgi apparait un petit grain, jaune sur des preparations traitées par l'acide osmique,—la première ebauche du corps vitellin." That is, the yolk-nucleus at first consists of Golgi elements embedded in a small mass which goes yellow in osmic acid (refer to his fig. 7). We are inclined to interpret this mass as a bed of closely aggregated mitochondrial granules. This mass is the " substance specifique " which in later stages appears in the form of concentrically arranged fibrils. Within and amongst these fibrils are the Golgi elements. This interpretation of ours receives support from Weiner's own observation that very rarely small granules may be found on the surface of the yolk-nucleus, which he interprets as mitochondria distinct from the grains elaborated by the Golgi apparatus and forming the " substance spécifique " (p. 158). In another place (p. 161) Weiner goes so far as to say that the addition of mitochondria to the substance of the capsule is very probable.

We are of the opinion that Weiner has not produced sufficient evidence which would justify placing the grains constituting the " substance spécifique " outside the pale of mitochondria.

In *Plexippus paykulli* we have not discovered any material in the yolk-nucleus which corresponds to the " substance spécifique " of Weiner. We consider the yolk-nucleus as a secondary aggregation of mitochondrial and Golgi material distinct from the primary juxta-nuclear mass in the oogonial cells. This latter, as is usually the case, is quickly dispersed in the cytoplasm, but the yolk-nucleus which appears at a later stage persists throughout oogenesis. It must be regarded merely as a well-defined centre of proliferation for the Golgi and mitochondrial elements.

Wilson (1906, p. 154) gives a diagram of the yolk-nucleus of the myriopod *Geophilus* according to Balbiani (1883). It will be found that the yolk-nucleus has been figured by Balbiani exactly as we have figured that of *Plexippus*.

(b) *Yolk Formation.*—The albuminous yolk granules appear for the first time at the periphery of the cytoplasm. There is no evidence whatsoever of their origin either from the mitochondria or the Golgi elements dispersed in the general cytoplasm. Not have they any connection with the yolk-nucleus, which is situated at a distance from the peripheral cytoplasm and
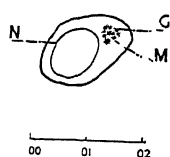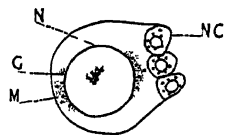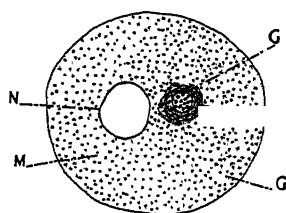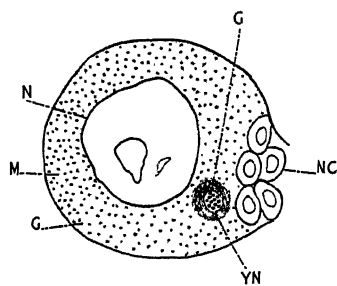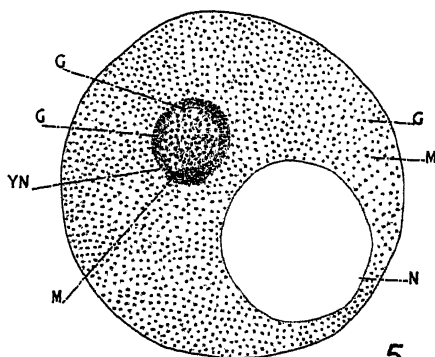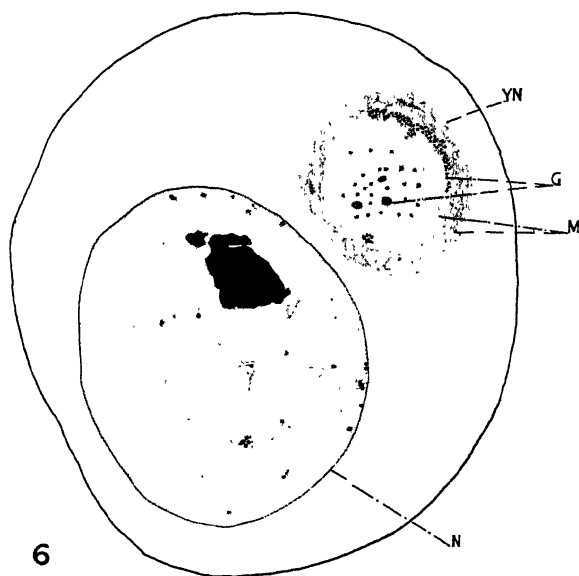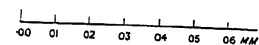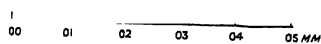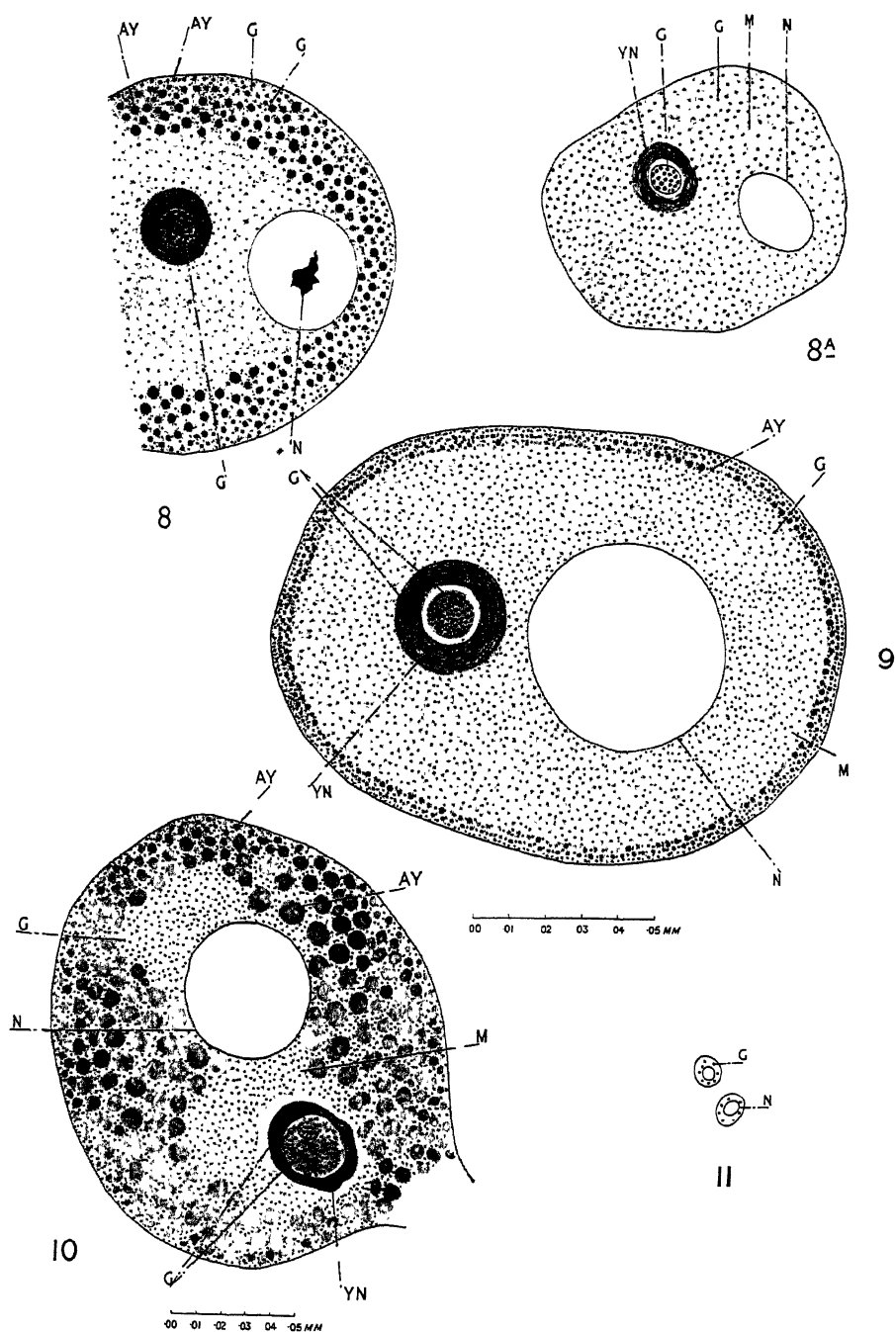
which, as already mentioned, remains intact throughout oogenesis. In other words, yolk seems to arise *de novo* in the cytoplasm as in *Crossopriza* and in *Pholcus*. Gradually the yolk granules invade the interior till the whole cytoplasm is packed with them. At the same time the yolk granules grow in size, and in advanced oocytes many of them become vacuolated.

It has already been mentioned that (1) the Golgi elements, both in the yolk-nucleus and the general cytoplasm, are blackened in Champy and tend to decolorize in Canada balsam ; that (2) they can be darkened in osmic acid in a few minutes ; and that (3) some of them grow slightly in size. From these reactions it must not be argued that they are fat droplets. On the other hand, they are intensely blackened like the typical Golgi apparatus in Da Fano and Kolatchev ; and after Kolatchev they resist decolorization. We therefore conclude that the Golgi elements of *Plexippus* consist of highly unsaturated lipoids, and not fats. This view is further supported by the fact that Sudan III and Scharlach R, which are tests for true fats, have no effect whatsoever on the material under discussion.

Nath (1928) described the swollen Golgi elements of *Crossopriza* as fatty yolk derived from the Golgi elements, inasmuch as the former went black in short periods of osmication. We have now used Sudan III and Scharlach R on this material also, and find that these dyes do not at all stain the swollen Golgi elements. It has therefore to be concluded that in *Crossopriza* also the Golgi elements consist of highly unsaturated lipoids.

Summary.

I. In the oogonium the mitochondrial granules and the Golgi spheres are aggregated in a juxta-nuclear mass. Early during growth period they spread out uniformly throughout the oocyte.

II. When the oocyte measures a little more than 0·08 mm. the yolk-nucleus puts in its appearance. From the very beginning it is differentiated into a cortex and a medulla. It grows in size but remains intact throughout oogenesis. Even in living oocytes it stands out with great clearness and can be easily microphotographed. It is a structure of remarkable solidity, so much so that it retains its spherical form even after the egg is ruptured.

III. The cortex of the yolk-nucleus consists of concentrically arranged fibres which have been interpreted by us as closely aggregated, aligned mitochondrial granules.

IV. Mitochondrial granules are present in the medulla also, but they are generally marked by the bigger Golgi spheres. These latter exist amongst the cortical fibres also.

V. According to Weiner the yolk-nucleus of *Tegenaria* also consists of Golgi elements, mitochondria, and a " substance specifique " secreted by the Golgi material. No such substance has been discovered by us in *Plexippus*.

VI. The yolk-nucleus of *Plexippus* must be regarded merely as a secondary centre of proliferation for the mitochondria and the Golgi elements.

VII. The albuminous yolk seems to arise *de novo* at the periphery of the egg (cf. *Crossopriza*). There is no evidence of their origin either from the mitochondria, the Golgi elements, or the yolk-nucleus.

EXPLANATION OF FIGURES.

Fig. 1.—Oogonium. Champy unstained.
Fig. 2.—Absolutely fresh oocyte measuring 0·042 mm.
Fig. 3.—Absolutely fresh oocyte measuring 0·086 mm.
Fig. 4.—Absolutely fresh oocyte measuring 0·1 mm.
Fig. 5.—Champy-Hæmatoxylin.
Fig. 6.—Bouin and iron-hæmatoxylin.
Fig. 7.—Fresh oocyte measuring 0·15 mm.
Fig. 8.—A portion of an oocyte measuring 0·3 mm. and osmicated for 4½ minutes.
Fig. 8A.—An oocyte measuring 0·13 mm. and osmicated for 10 minutes.
Fig. 9.—Koltachev unstained.
Fig. 10.—Da Fano untoned.
Fig. 11.—Fresh nurse cells each measuring 0·01 mm.

LETTERING.

A.Y.—Albuminous yolk.
G.—Golgi elements.
M.—Mitochondria.
N.—Nucleus.
N.C.—Nurse cells.
Y.N.—Yolk-nucleus.

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X.—A GENERAL METHOD OF QUANTITATIVE MICROCHEMICAL 545. 83. ANALYSIS. I. THE DETERMINATION OF CALCIUM.

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THE facility and exactness with which extremely small amounts of substances may be identified upon the microscope slide often leads one to deplore the lack of a similar quantitative method. This is particularly true in cases where the amount of material available for analysis is very small, as is often the case with dust or fume samples or where some normal or toxic substance is of importance in biological material when the quantity of the latter is restricted.

The chief difficulty in adapting qualitative methods to exact estimation in a truly microscopical sense is that any manipulation with respect to filtration and washing brings in the limiting factor of solubility. Furthermore, if weighing is resorted to, the difficulty in determining the exact weight of a few micrograms is very great. In weighing, aside from difficulty in removal of water, temperature effects, the adsorption of water vapour or of gases by the substance weighed, and assuming an adequate microchemical balance, there is also the disparity of the substance weighed to the weight of the containing vessel—an often neglected but important factor. In any case the degree of care necessary to be exercised has, except in very few instances, evidently retarded the extension of gravimetric procedure to this field of present interest.

An alternative method lies in the measurement of the *volume* of precipitate produced rather than the weight. Very little attention has been devoted to such measurements in analytical chemistry, chiefly because of uncertainties with respect to homogeneity and packing of the precipitate, and because the gravimetric method with the large quantities involved is so much more direct. The method of visual estimation has, however, much to commend it if it can be made practical. It is rapid, and the only limitations imposed for micro purposes would appear to be the crystalline nature of the precipitate and the relative size of the containing vessel with respect to that of the crystals or particles of precipitate.

The initial experiments in this investigation in which measurements were made of the volumes of precipitates produced of the order of a few micrograms in weight, indicated that with certain refinements such a method was feasible. A volumetric method on a much larger scale has been used by Strzyzowski (1913) for the determination of albumin in urine, by Hamburger (1915, 1916, 1921) for the determination of potassium and sulphates, by Bazin (1920) for determining the number of bacteria in a suspension, and by Kleinmann (1919) for the determination of phosphoric acid. The apparatus used by these investigators consisted of a bulb terminating in a graduated capillary tube in which the volume of precipitate could be read directly from the graduation marks on the tube. However, these investigators were interested in the determination of relatively large amounts (milligrams) of material, whereas our attempt has been to find a method suitable for the determination of micrograms of material.

Experimental Part.

For the microvolumetric precipitation of a substance from a few drops of solution and its estimation under the microscope a special form of container
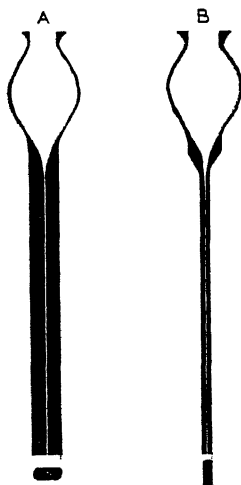
FIG. 1.

is necessary. The type of precipitation tube that was finally found to be suitable for the determination of these minute amounts of substance is that shown in fig. 1, A. It consists of an extremely fine capillary tube terminating in a bulb of 0·5–0·8 c.c. volume. Although a much shorter tube can be used, the capillary portion was made 6–7 cm. in length for convenience in examination on the microscope stage. The fine capillary tubing known as thermometer tubing is suitable for the fabrication of these tubes. The precipitation tube is open at the lower end for convenience in removing old

precipitates and for cleaning; otherwise the capillary is so fine that if the lower end is glass sealed it is extremely difficult to clean the tube. Originally tiny glass plates were sealed to the lower end with Canada balsam, but later it was found that the balsam alone is sufficient. When the balsam is carefully cooked and allowed to rise in the tube for 2–3 mm., it sets on cooling to a glassy-like mass which is not penetrated nor deformed by the precipitate when centrifugalized, and which, when required, can readily be removed from the tube by warming.

The length of the column of precipitate in the tube was measured by means of a Leitz 2× eye-piece micrometer with movable scale, which in turn was calibrated by means of a stage micrometer. The objective used was a Leitz 1a (33–24 mm.). The tube was mounted upon a small carriage integral with the mechanical stage so that it could be moved to any desired position.

The curved outer surface of any ordinary capillary tube makes reading difficult and inaccurate under the microscope, and for that reason two opposite sides of the precipitation tubes were ground optically flat and polished so that the tubes had the shape shown in fig. 1, B. With this arrangement readings were sharp and free from distortion. The precipitation tubes were fitted into wooden holders which had been turned to the dimensions of a 15 c.c. centrifuge tube and which fitted into the usual centrifuge cups. The speed of the centrifuge under load was 2800–3000 r.p.m. and could be varied by means of a rheostat. With crystalline substances the rate of centrifuging is not of great importance, although the opposite is decidedly true with amorphous precipitates.

With crystalline precipitates the volume of the precipitated mass is affected by the condition of the crystals irrespective of the rate of centrifugalization. Great irregularity of size and shape is reflected in variation in the voids and hence in the space occupied by the precipitate.

The tubes should be chosen of such diameter that the maximum length of column will be obtained with optimum packing. The tubes used had capillaries varying from 0·2–0·3 mm. in diameter. In the determination of calcium, since the calcium crystals averaged 15 microns in length, ample space was therefore provided for the crystals to fall through the capillary without jamming. Direct measurement of the tube gave (for tube # 3, for instance) the volume as $3·93 \times 10^{-6}$ c.c. per division of the eye-piece micrometer, whereas calibration by weighing the contained column of mercury gave $4·03 \times 10^{-6}$ c.c. per division. For purposes of analysis, however, the tubes were calibrated in terms of known amounts of calcium as calcium oxalate, chlorine as mercurous chloride, etc.

For accurate measurement of the small amounts of solution used for analysis the commercial 1/10 c.c. pipette is not sufficiently exact. Special pipettes were therefore made of thermometer tubing by blowing a small bulb in the middle of a convenient length and ringing the tube at points on either side of the bulb by means of a diamond (fig. 2). The tube being

drawn to a fine elongated point at one end diminishes the tendency of the liquid to run back on the tube as it is being delivered. Calibration was effected by weighing the volume of mercury held between the two marks. The volumes of the two principal pipettes were $5 \cdot 657 \times 10^{-2}$ c.c. and $9 \cdot 050 \times 10^{-2}$ c.c. Considering the accuracy and convenience of these pipettes, they are easily made and calibrated.

In some cases it is necessary to ash material before analysis in order to destroy any organic matter that might interfere. A platinum spoon having a volume of slightly less than 1 c.c. was used for this purpose. It was heated in a muffle constructed from an alundum extraction thimble having a hole bored at one end through which a gentle stream of filtered air was passed over the heated surface. The material in the spoon was first dried

Fig. 2.

Fig. 3.

at the mouth of the muffle and the ashing completed within the muffle at a bright-red heat.

No matter how careful the ashing a few microscopic particles of carbon are usually not oxidized. Although the total volume of these may be of no consequence, they are objectionable because they act as crystallization nuclei and often promote the formation of undesirably large crystals. For this reason it is always well to filter the acid ash solution.

Quantitative filtration and washing of a drop or so of a suspension is difficult, but a simple form of micro filter was developed which was found to be very satisfactory. These filtration tubes were made of thin-walled Pyrex tubing of 1 mm. bore by 70 mm. in length, with a crook at one end and slightly constricted a few millimetres from the mouth (fig. 3). The filtering medium used was the long-fibred material of which Japanese lens paper is made. This should be torn into strips and suspended in strong hydrochloric acid for two or three minutes. The pulp is then thoroughly washed with distilled water until acid free and finally suspended in distilled water.

A little of this pulp taken up with a glass needle and placed in the mouth of the filtering tube forms an efficient filter. The tube, when full of water, forms a syphon which begins to operate only when the mouth is placed in a drop of the liquid to be filtered. When this drop is drawn into the tube the syphon stops working but does not break. Successive drops are thus drawn into the tube, so that a drop of liquid can be filtered quantitatively and well washed without unduly increasing the volume of the filtrate. The liquid runs through the filter at the rate of about one drop per minute.

Potassium, Sulphates, and Chlorides.

Preliminary experiments with the determination of potassium, chlorides, and sulphates showed that these substances are more difficult to determine in micro amounts than calcium. Determination of potassium as the chloroplatinate is out of the question because of its solubility, and its determination
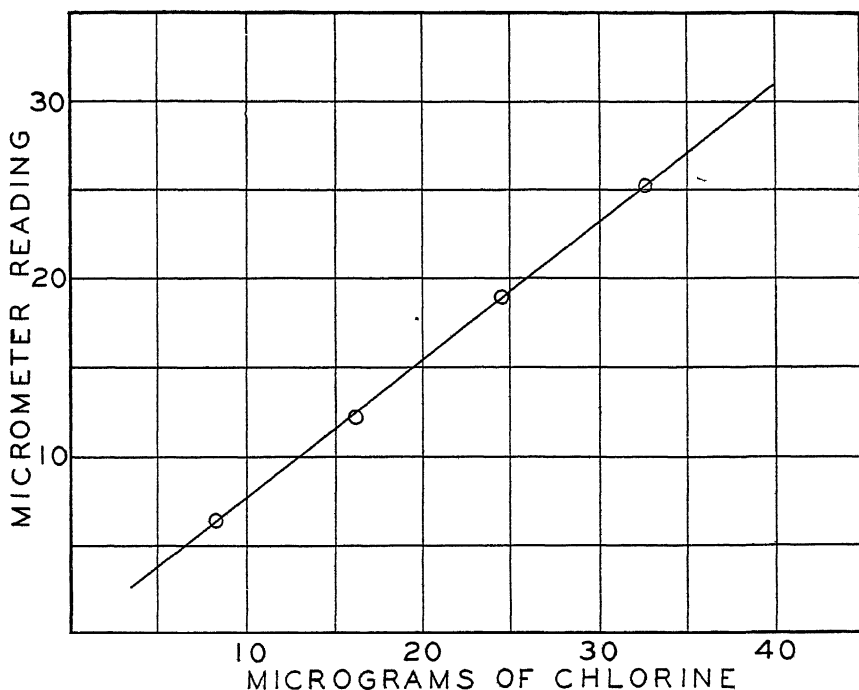
Fig. 7.

as cobalti-nitrite has so far shown vagaries which are inconsistent with accuracy. On the other hand, the precipitate consists of a fine-grained crystalline deposit (fig. 4) which would seem adaptable to this type of determination. Sulphates, precipitated as barium sulphate, also yield a crystalline precipitate of small, fairly uniform crystals (fig. 5), but the crystals exhibit such a pronounced tendency to float and to creep up the

sides of the bulb that no accuracy could be attained in the analysis. Chlorides, on the other hand, gave much more consistent results. It is undesirable to precipitate the chlorides as silver chloride owing to the amorphous nature of the precipitate and the consequent variation in volume. Attempts to precipitate crystalline silver chloride by slowly neutralizing an ammoniacal solution of silver chloride with acid vapour gave poor results. However, precipitation as mercurous chloride (fig. 6) gave good results in pure aqueous solution of chlorides (fig. 7). The crystals are even in size and tend to pack uniformly. In ashed specimens of blood, however—perhaps owing to the presence of other salts—the results obtained so far have not been of the desired accuracy. On the other hand, the technique for the determination of calcium in blood has presented no great difficulty.

Calcium.

Preliminary determinations of calcium in accurately prepared solutions of calcium chloride made from calcite or from pure calcium oxide dissolved in hydrochloric acid gave encouraging results, but indicated that for accuracy all the factors concerned in precipitation must be under careful control. Once the conditions are known the procedure is relatively simple. It was found, for instance, that the crystalline condition of the precipitate is a
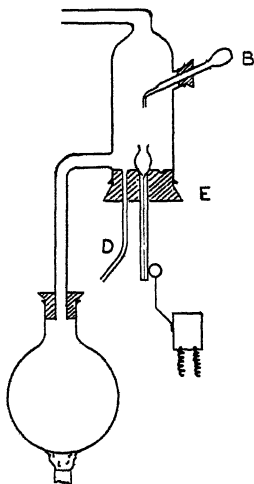
Fig. 12.

factor of much importance. As ordinarily precipitated by the addition of ammonium oxalate and ammonia to a boiling solution of the chloride, calcium oxalate is precipitated as a chaotic mass of crystals of various sizes and distorted shapes—usually in large groups or clusters (fig. 8). Very slow neutralization by means of buffers gives somewhat better results, but also yields distorted crystal forms (fig. 9). Finally, it was found that good results could be obtained by slow neutralization with the vapour of ammonia,

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 8.

Fig. 9.
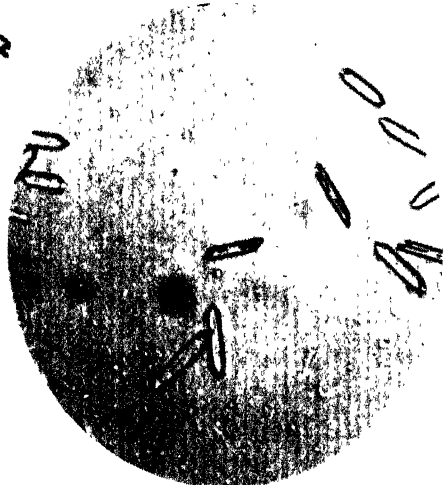
Fig. 10.
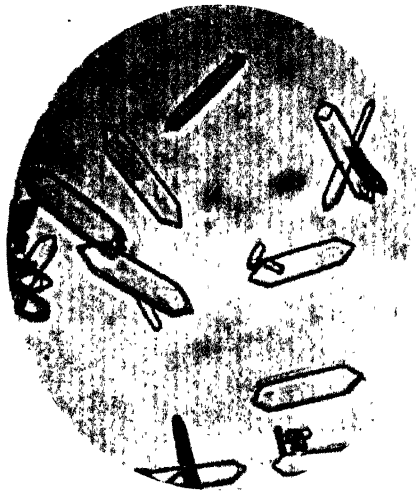
Fig. 11.
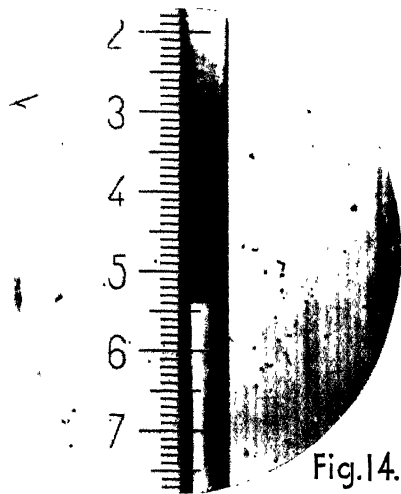
Fig. 14.

brom cresol purple being used as indicator. Ammonium hydroxide evolves
ammonia gas too rapidly for this purpose, so that it is preferable to use a
1 per cent. solution of ammonium carbonate, which, when slowly boiled,
evolves ammonia at the proper rate. After the solution of calcium chloride
and oxalic acid is neutralized, crystals of calcium oxalate slowly form and
can be promptly carried to the bottom of the precipitation tube by tapping
the latter. The crystals formed by this means are largely single crystals of
one definite form (figs. 10 and 11) and, while the variation may range from
10 to 30 microns in length, the readings are substantially identical. As it
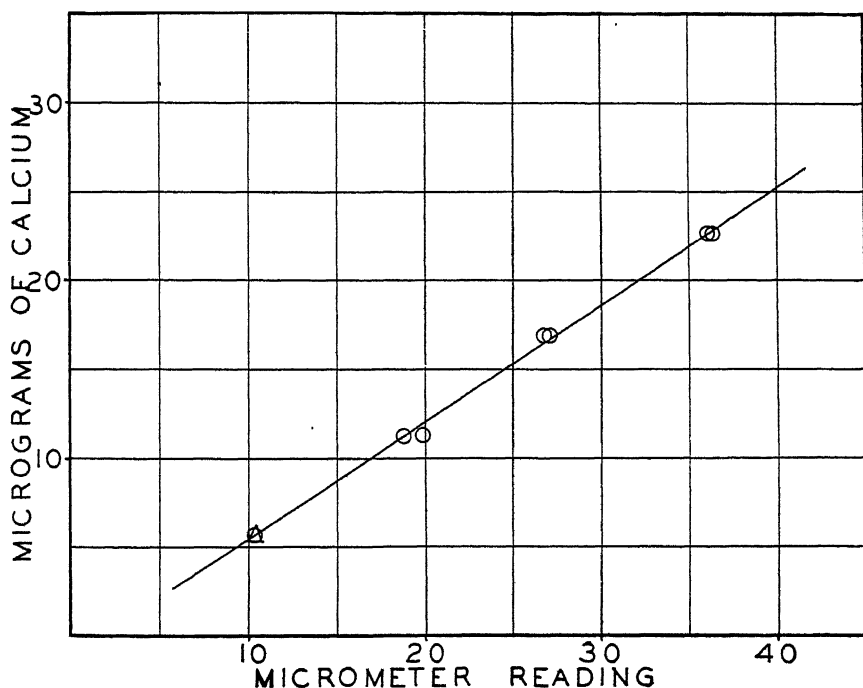
Fig. 13.

is obviously impossible to boil the few drops of liquid in the bulb by direct
heating without some loss, the tube was heated within a glass vessel by
means of steam (fig. 12). The hole in stopper E was bored oversize so that
the tube is but loosely held. D serves to carry off the condensate, and B
represents a pipette which permits one to add various reagents without
cooling the precipitation tube. An electric tapper shakes the precipitated
crystals into the lower part of the tube. Alternate heating, tapping, and
centrifugalization are necessary in order to precipitate the calcium
quantitatively.

The results obtained with known amounts of calcium chloride under such
conditions indicate a direct linear relationship of volume of precipitate to
amount of calcium (fig. 13). This is not true in the case of amorphous

precipitates, such as copper ferrocyanide, or zinc sulphide. In the determination of these two metals, particularly that of zinc as sulphide, one obtains curves which tend to flatten out with increasing amounts. While tubes may be calibrated with respect to either of these substances, there is a packing tendency which is not apparent with the more definitely crystalline precipitates.

Procedure for Calcium in Blood or other Biological Fluids.

The method adapted to the analysis of blood, or of serum, is as follows : Measure with the greatest care exactly one pipetteful of serum (about 0·1 c.c.) into the platinum spoon and add two drops of nitric acid. Slowly evaporate the liquid to dryness before the muffle and then ash. Meanwhile clean and dry the calibrated precipitation tube and seal the lower end. For this purpose drop some of the prepared balsam on to a hot plate, and when it has reached the correct consistency touch it with the end of the precipitation tube. After sufficient balsam has entered the tube, cool, and centrifugalize a drop of water in it so that the capillary column is quite filled with water. Dissolve the serum ash in one drop of N/1HCl, add two or three drops of water, and filter by means of the filtration tube directly into the bulb of the precipitation tube.

After all the solution of ash has been drawn into the filtration tube wash the inside of the spoon with successive drops of water until satisfied that all the soluble material has been transferred to the tube. Gently evaporate the solution in the bulb by heating with a fine blast of filtered and heated air until the bulb is no more than half full. Add two or three drops of 1 per cent. filtered oxalic acid solution, a drop of brom cresol purple indicator, and place the tube in the heater. Bring about 100 c.c. of 1 per cent. ammonium carbonate solution in the flask of the heater *very slowly* to the boiling point and commence tapping the tube. It usually requires 5–10 minutes after steam strikes the bulb before the liquid within is neutralized. Continue tapping from this point for 15 minutes and then centrifugalize for a few minutes. Replace the tube in the heater and continue the heating and tapping for an hour. If any crystals are visible in the bulb on examination with a lens, add a drop of recently filtered 5 per cent. saponin solution and two or three drops of redistilled ether. On gently agitating the liquid until it froths, any crystals that may be floating subside and may be thrown down in the centrifuge. It is usually best to allow the tube to stand overnight at this point. After recentrifugalizing again examine the upper part of the liquid with a lens to make sure that the fluid is entirely clear and free from crystals. Measure the length of the column of crystals under the microscope (fig. 14) and check the reading by tapping and recentrifugalizing. The tube may be calibrated by using amounts of calcium chloride solution containing from 5 to 25 micrograms of calcium, as this gives convenient lengths of column for microscopic reading.

Discussion.

In order to test the applicability of this method, analyses were made of blood serum by the technique described above. The results are shown in Table I. The average error in this group of analyses is 0·45 microgram with a deviation from the mean of 0·21. This represents an average error of slightly less than 5 per cent. in the calcium determination of a sample of blood serum of one-tenth of a cubic centimetre in volume.

TABLE I.

MICROSCOPIC DETERMINATION OF CALCIUM IN BLOOD SERUM.

(0·0905 c.c. of serum having a calcium content of 10·15 μ-gs.* used for each analysis.)

Number	Micrometer Reading †	Calcium content by Micro-analysis μ-gs.	Error μ-gs.	Deviation from Mean
1	23·9	9·3	0·85	0·40
2	24·9	9·7	0·45	0·05
3	26·2	10·2	0·05	0·40
4	24·2	9·4	0·65	0·20
5	25·2	9·8	0·35	0·10
6	24·9	9·7	0·45	0·00
7	25·5	10·6	0·45	0·00
8	24·8	10·3	0·15	0·30
9	25·3	10·5	0·35	0·10
10	24·5	10·2	0·05	0·40
11	27·6	11·5	1·35	0·90
12	22·8	9·5	0·65	0·20
13	25·3	10·5	0·35	0·10
14	25·0	10·4	0·25	0·20
15	25·3	10·5	0·35	0·10
16	25·5	10·6	0·45	0·00
	Average ..	10·17	0·45	0·21

While the accuracy attainable with this method is commensurable with that of the macro methods, it is not suggested as a substitute for clinical purposes, since the difficulties in manipulation are obviously somewhat greater. There are cases, however, where it may be desirable to find the calcium content of such body fluids as peripheral lymph or synovial fluid, which are available in such small quantities only, or the blood of very small animals or of insects, when this fluid may only be obtained in such very small amounts that a macro calcium analysis is difficult or out of the question.

Summary.

A microscopical means of quantitatively determining minute amounts of various substances is described. With this method blood calcium analyses

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* Average figure determined by macro analysis of 25 c.c. portions.
† Tube ♯ 8 used for Nos. 1–6 inclusive; tube ♯ 3 for Nos. 7–16

may be made with satisfactory accuracy upon samples of serum as small as one-tenth of a cubic centimetre in volume.

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EXPLANATION OF FIGURES.

Fig. 1.—Precipitation tube.
Fig. 2.—Micro capillary pipette.
Fig. 3.—Syphon filtration tube.
Fig. 4.—Potassium cobalti-nitrite crystals × 700.
Fig. 5.—Barium sulphate crystals × 700.
Fig. 6.—Mercurous chloride crystals × 700.
Fig. 7.—Micrometric determination of chlorides.
Fig. 8.—Distorted calcium oxalate crystals × 700.
Fig. 9.—Distorted and clumped calcium oxalate crystals × 700.
Fig. 10.—Type of calcium oxalate crystal necessary for exact results × 700.
Fig. 11.—Necessary form of crystal. Calcium oxalate from grasshopper blood × 700.
Fig. 12.—Heater for precipitation tube.
Fig. 13.—Micrometric determination of calcium.
Fig. 14.—Appearance of a typical calcium oxalate precipitate in the precipitation tube × 22.

XI.—A NOTE ON THE FORAMINIFERAL GENUS *BOLIVINOPSIS* 593. 12.
YAKOVLEV.

By W. A. MACFADYEN, *M.C.*, Ph.D., Sedgwick Museum, Cambridge.

(Read May 17th, 1933.)

ONE TEXT-FIGURE.

IN 1891 V. Yakovlev described and figured a form from the Cretaceous of the Kursk District, South Central Russia (roughly in Lat. 52° N., Long. 36° E.), under the name *Bolivinopsis capitata* gen. et sp. nov.* I think that, on the evidence of the foraminiferal fauna which he figures, there can be no doubt that it is of Upper Cretaceous age. This is indicated by such forms as his *Textularia striata* Ehrenberg and "*T. conulus* Reuss" (both apparently species of *Pseudotextularia*), *Sagraina aspera* Marsson (=*Eouvigerina*), *Globigerina cretacea* d'Orbigny (? partly = *G. aspera* Ehrenberg sp.), and *Rotalina exsculpta* Reuss. These are figured sufficiently clearly to preclude mistake. Yakovlev's paper is in Russian with no summary in a second language, and perhaps partly in consequence of this, and of the not very ready accessibility of the periodical in question, it has not often been referred to by later authors. Its importance from the point of view of nomenclature lies in the erection of the new genus, which appears to invalidate the generic name *Spiroplectoides* Cushman, 1927.

The description and figure leave something to be desired, in that there is no mention of the aperture, nor of the thickness and nature of the edge of the test, and the single figure gives only one view. But the evidence given is, I think, adequate to fix the genus without doubt. There is no generic diagnosis, and it is not definitely stated whether the shell-wall of the species is arenaceous (or siliceous) or hyaline. Apart from the implication of the name, however, there is the definite statement on p. 342 that all the foraminiferal species investigated belong to the group "Perforata calcarea," and this is supported by the figured forms, *B. capitata* being the only one of which there might otherwise have been doubt. I am greatly indebted to Prof. W. Kasanzeff of Leningrad for kindly sending me a translation in German of the necessary part of Yakovlev's paper. I have further

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* "Description de quelques espèces des foraminifères crétacés," *Trav. Soc. nat. Univ. Imp. Kharkov*, xxiv, 1890 (1891), pp. 341–364, pls. i–iii. I am indebted to Mr. A. C. Townsend, Librarian of the British Museum (Natural History), for the transliteration of the author's name in accordance with the system used at the British Museum. The name in the French title in the index of the volume in which the paper occurs is spelt W. Jakowlew.

translated this (freely) into English below, but while the precise wording may have been altered in the double translation, I think the meaning is clear.

Yakovlev states that the material at his disposal consisted of preparations mounted in Canada balsam. The determinations were often made difficult by the unfavourable position of the shells, and were thus somewhat dependent on the degree of their transparency; in some cases he succeeded in removing the cover-glass by softening the balsam by heating, and in altering the position of the shells. He describes the species thus:

" *Bolivinopsis capitata* nov. gen. et n.sp.—The shell is long and straight, gradually diminishing in size from top to base, but the lower end is thickened into a head. In this head-like thickening the chambers are indistinctly spirally arranged. In the centre of the thickening lies a rounded initial

Φ. 24.

Bolivinopsis capitata Yakovlev, ×180 (enlarged from the type-figure).

chamber, somewhat larger than the next following. It is surrounded at the sides and below by four oval chambers which succeed it; two wider chambers cover the central chamber above and initiate two nearly parallel, upward-growing tiers of chambers. The sutures between the chambers are slightly sunken. Each tier contains 9–10 elongate oval chambers (perhaps more, since the figured specimen may not be a complete shell). These chambers are laid together next to and over one another in regular alternation, and are arranged obliquely to the long axis of the test, so that in this upper part of the shell the chambers are disposed in the same manner as in the genus *Bolivina.*

" From the arrangement of the upper and lower portions it may be seen that this form is transitional between the biserial Textilaridea and the spirally arranged Globigerinidea.

Length of the whole test	..	..	..	.. 0·35	mm.
Length of the head	..	..	..	.. 0·07	,,
Breadth ..	.. ..	..	..	.. 0·11	,,
Breadth at the neck	..	..	..	.. 0·067	,,
Breadth at the head	..	..	..	.. 0·08	,,

" Found only in one preparation, No. 4, from Chernetchina, and perhaps a broken fragment in preparation No. 3." [End of translation.]

There is only the one species of the genus mentioned, and the genotype of *Bolivinopsis* is therefore *B. capitata* Yakovlev. In my opinion this species is probably a synonym of *Spiroplecta rosula* Ehrenberg (described from the Chalk of the Mississippi Valley, U.S.A.), which is the genotype of *Spiroplectoides* Cushman. In this case the synonymy would include the following :

Bolivinopsis rosula (Ehrenberg).

1854 *Spiroplecta rosula* Ehrenberg, " Mikrogeologie," pl. xxxii, ii, fig. 36.

1891 *Bolivinopsis capitata* Yakovlev, *Trav. Soc. nat. Univ. Imp. Kharkov,* xxiv, 1890 (1891), p. 349, pl. i, fig. 24.

1927 *Spiroplectoides rosula* (Ehrenberg); Cushman, *Contrib. Cushman Lab. Foram. Research,* ii, p. 77.

The type figures of both *B. rosula* and *B. capitata* are drawn from one view only of a specimen mounted in Canada balsam, and consequently neither is altogether adequate. There is a certain amount of difference between the two figures, which might be explained on the theory of trimorphism, in which case *B. rosula* would be the A_1 form and *B. capitata* the A_2 form.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(*Under the direction of* G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE, STAINING.

The History of Staining.—H. J. CONN ("The History of Staining: Sir John Hill: Rudolph Heidenhain," *Stain Technol.*, 1933, **7**, 4–10, 2 pls.). Brief biographical notes, with portraits, are given of Sir John Hill, 1716 or 1717–75, and Rudolph Heidenhain, 1834–97. The former is worthy of remembrance as in a pamphlet on the construction of timber in which he described the method of making microscopic sections of stems he recommended placing them in a solution of carmine to allow the dye to ascend through the vessels. He is thus the earliest pioneer in the use of dyes for microscopic purposes. G. M. F.

Bielschowsky's Staining Technique.—R. H. BEECH and H. A. DAVENPORT ("The Bielschowsky Staining Technic—A Study of the Factors influencing its Specificity for Nerve Fibres," *Stain Technol.*, 1933, **7**, 11–30, 1 pl.). A comparison is made of the results obtained when adult mammalian tissue is stained in bulk, introducing variations into each separate step. The following conclusions were reached. No specific means for inhibiting the staining of connective tissue and still permitting complete staining of nerve fibres was found, though avoidance of overstaining was of importance. Overstaining could be corrected by reducing the concentration of the silver nitrate bath or by adding an excess of ammonia to the ammoniated silver bath. Staining of fine fibres was favoured by adding acetic acid to the formaldehyde used for fixation or by adding pyridine to the silver nitrate bath. Four days' fixation was sufficient; prolonged fixation increased the intensity of the stain. Extraction of lipins with ammoniated alcohol gave results similar to those obtained after extraction with pyridine, but the stain was lighter. Impregnation with 1·7 p.c. (0·1N) silver nitrate solution was quite satisfactory and variations in the concentrations of this bath suggested that the practical limits of satisfactory concentrations lie between 0·3 and 3 p.c. It is of advantage to wash in 2·5 p.c. acetic acid between the ammoniated silver bath and the formaldehyde reduction. G. M. F.

Fixation by Drying and Freezing.—I. GERSH ("The Altmann Technique for Fixation by Drying while Freezing," *Anat. Rec.*, 1932, **53**, 309–37). Altmann's method of fixation and dehydration *in vacuo* at temperatures of — 15 to — 20° C. has received little attention owing to the lack of a very suitable apparatus. A new and improved form of apparatus is here described. Excellent cytologic fixation has thus been obtained for skin, cartilage, smooth muscle, liver, and pancreas, though with the central nervous system the results were poor. G. M. F.

The Action of Hardening Fluids on Animal Tissues.—W. GROSS and H. LOHAUS (" Untersuchungen über die Wirkung von Härtungsflüssigkeiten auf tierische Gewebe," *Ztschr. f. Wiss. Mikr.*, 1932, **49**, 168–90). The concentration and pH of various substances used for fixing and hardening tissues are discussed in relation to their action on cells, a table being given of quantitative data of the effects of various solutions. A fluid of appropriate osmotic pressure with a minimum amount of shrinkage and good penetration is proposed. Dissolve 12·404 gms. of boric acid in 100 c.c. normal NaOH and dilute with 900 c.c. of water. Mix 480 c.c. of N/10HCl with 520 c.c. of the above described solution. Adjust to pH 7·6 with alkaline boric acid solution or HCl. Next add 1 gm. of dry potassium bichromate and 1 gm. CaCl$_2$ to 100 c.c. of the solution. Add 3·5 c.c. of 40 p.c. formalin to every 100 c.c. before using the fluid. The final pH should be 7·2 ; filter if a whitish precipitate forms. Various stains may be used with this fixative, but the silver method is unsuitable. For the nervous system the fixative is excellent for Nissl's stain, while there is good differentiation in Weigert's procedure if mordanted with copper acetate. As the reaction is slightly alkaline there is no dissolving of Fe or Ca, and even in preparations with a large amount of blood no precipitates appear.

G. M. F.

A New Mounting Medium for Museum Specimens.—T. SHENNAN and W. A. NELSON (" A Cheap and Apparently Efficient Museum Mounting Medium," *J. Path. & Bact.*, 1933, **36**, 486–7). A cheap but efficient mounting medium is prepared from sodium acetate 100 gms., liquid glucose (B.P.) 400 c.c., and boiled water. The acetate and glucose are dissolved in the boiled water while it is still hot. The pH of the mixture is 8, the specific gravity 1080. Commercial liquid glucose can be used in place of the B.P. product. Thymol is generally added to the water, but 1 p.c. potassium bromide may be used in cases where brains are to be preserved. G. M. F.

Tissues Stained with Trypan Blue.—D. C. HETHERINGTON and E. H. TOMPKINS (" The Fixation of Tissues Vitally Stained with Trypan Blue," *Stain Technol.*, 1933, **8**, 31–34). Formalin as a fixative for tissues vitally stained with trypan blue is not entirely satisfactory. The following fixative is therefore recommended : Chloroform, 2 parts ; absolute ethyl alcohol, 2 parts ; glacial acetic acid, 1 part ; mercuric chloride to the point of saturation. The tissues should be fixed for 1–2 hours ; transferred to 95 p.c. ethyl alcohol for 12 hours ; to absolute alcohol for 12–24 hours ; to a mixture of absolute alcohol and xylol for $\frac{1}{2}$ hour ; and finally to xylol, before embedding in paraffin. Cedar oil may be used for clearing in place of xylol, in which case the tissues should be transferred from absolute alcohol to a mixture of absolute alcohol and cedar oil for 24 hours before placing in cedar oil alone. Various counterstains may be used. Mayer's hæmalum is very satisfactory. G. M. F.

Insoluble Lime Salts in Tissues.—G. GÖMÖRI (" Microtechnical Demonstration of Insoluble Lime Salts in Tissues," *Amer. J. Path.*, 1933, **9**, 253–60, 1 pl.). With microtechnical methods hitherto described insoluble lime salts can be demonstrated only if the tissue is soft enough for the microtome knife. If the tissue can be made sectionable only by decalcification, calcium salts can no longer be detected. In the author's method the lime salts are stained in blocks of fixed tissue before decalcification by the addition of silver salts. These combine with the calcium phosphates to form an insoluble silver phosphate, which is then reduced to metallic silver. On subsequent decalcification the calcium salts are removed while black metallic silver is seen at the site of the lime salts. The actual technique

is as follows : Cut or saw thin blocks of fresh tissue 1–2 mm. thick, fixed in 80–96 p.c. alcohol for 2–4 days, or boiled for 5 minutes in a 2 p.c. potassium nitrate or a 5 p.c. alum solution in 20 p.c. alcohol. Afterwards the tissue is washed in distilled water for 3–4 hours. Impregnate in 1·5 p.c. silver nitrate solution for 6–10 days, changing the silver solution once or twice. Wash for 3–4 days in distilled water changed daily four to five times, till the last washing water decanted does not show the slightest turbidity when mixed with hydrochloric acid. Reduce in a 5 p.c. solution of sodium hyposulphite. Before use add 4–5 drops of a 0·1 normal sodium hydroxide solution to each 100 c.c. of reducer. Keep blocks in reducer for 4–8 days. Wash in running water for 3–4 hours. Fix in a 3–5 p.c. solution of sodium thiosulphate for 2 days. Wash in running water for at least 24 hours. Decalcify in a 6–8 p.c. solution of sulphosalicylic acid, wash, embed, and section. From the moment of impregnation with the silver nitrate till removing from the thiosulphate solution all manipulations must be carried out in the dark. G. M. F.

The Staining of Amœbæ.—E. H. MYERS (" A New Technique for making Amœba Slides," *Trans. Amer. Micr. Soc.*, 1933, **52**, 58–59). The following technique applies to free living amœbæ. Amœbæ from the bottom of a culture dish are removed with a pipette and placed on a freshly cleaned culture dish. The amœbæ soon settle to the bottom and the supernatant fluid is decanted off. Wash the concentrated amœbæ several times with water filtered from the cultures, allowing the amœbæ to settle and become attached after each washing. The amœbæ are then activated by a stream of filter red media from a large pipette ; they are then allowed to settle and the fluid decanted, leaving the bottom of the dish barely covered with water. Fix with 20 c.c. of Bouin's solution at 65° C. ; after a few minutes add 20 c.c. of 85 p.c. alcohol and carefully move up the few amœbæ adhering to the dish with a wide pencil eraser cut to a thin knife-edge. Place the amœbæ in a straight-walled centrifuge tube and centrifuge at low speeds, as high speeds displace the nucleus and jell the organisms. Remove the Bouin's fluid by several washings in 70 p.c. alcohol, then pass into 50 p.c. alcohol. Stain for 30 minutes in the least possible amount of Grenacher's borax carmine (Grübler's rubrum opticum carmine). After 30 minutes precipitate the stain to a brilliant-red mud by adding 10 p.c. HCl a drop at a time. Allow to stand for from 3 to 12 hours and differentiate with 70 p.c. acidified alcohol. A few organisms placed directly into absolute alcohol and then into carbo-xylol will serve to check the progress of differentiation. Wash in 70 p.c. alcohol and then transfer to 85 p.c. Counterstain by adding a few cubic centimetres of a transparent solution of indulin in 85 p.c. alcohol to the concentrated amœbæ. When they appear blue to direct illumination arrest the staining by filling the tube with fresh alcohol. Complete dehydration, clear in xylol, add thin balsam, and gradually strengthen to mounting consistency. G. M. F.

The Use of Copper Salts in making Preparations of Paramecium.— H. MERTON (" Die Verwendung von Kupfersalzen zur Herstellung von Paramæcium Präparate," *Arch. f. Protistenkunde*, 1932, **76**, 171–87). By the use of the following method the anterior and posterior ends of the organism are clearly revealed, showing the peristomal groove, nuclei, contractile and food vacuoles and cilia. Place a drop of a mature Paramecium culture on an albumen-glycerine slide. After 30 seconds add a drop of 2 p.c. copper sulphate, holding the pipette close enough to avoid unnecessary agitation, for 5 minutes. With weaker solutions a longer time may be used for fixation. Pipette off the fluid and place the slide face downwards over a 2 p.c. osmic acid solution for only 1 minute if the

solution is fresh. Add a few drops of saturated $HgCl_2$ for 10 minutes. If preparations are satisfactory place in 70 p.c. alcohol for 10 minutes, then in distilled water for 2 minutes. Formol and glacial acetic acid vapours may also be used for fixation. Stain with Hamburger's acid alum carmine with light green or with Heidenhain's hæmatoxylin with congo red. Heidenhain's aniline blue orange G gives good results after osmic acid fixation, the cilia, trichocysts, and cytopharynx being blue, the rest of the body orange. Dehydrate and clear thoroughly and mount with care, as the organisms become brittle. G. M. F.

A Method for Mounting Specimens of Drosophila on Microscopic Slides.—J. T. PATTERSON (*Science*, 1932, **76**, 258). The specimens mounted should be at least 2 days old as very young flies tend to become distorted. The concavity of an absolutely clean microscopic culture slide (depth 1·5 mm.) is covered with a thin layer of ever-ready mucilage or glue. Working under a binocular microscope the fly is arranged in the desired position in the centre of the cavity. The glue hardens in a few minutes and holds the fly in a definite position. The slide is transferred to equal parts of xylol and absolute alcohol for 30 minutes, then to absolute alcohol for at least 3 hours. Fill the cavity with Grübler's euparal and apply cover-glass. G. M. F.

A Method for the Fixation and Staining of Loose Connective Tissue Fibres in the Skin.—G. JASSWOIN ("Eine zuverlässige Herstellungs- und Färbungsmethode der Häutchen des lockeren Bindegewebes," *Ztschr. f. Wiss. Mikr.*, 1932, **49**, 191–94). This method shows up collagen and frequently elastic fibres, and the cytoplasm of fibroblasts. 5 gm. $MgCO_3$ is added to 100 c.c. of commercial formalin, shaken, filtered, and then diluted to 12 p.c. With as little exposure to air as possible, fix tissues for at least $\frac{1}{2}$–1 hour. For small objects like mice the whole animal is submerged in the fixative, the skin being pulled off therein. With sharp scissors a small portion (1 × 10 mm.) is removed from the transparent surface, transferred to an albumen-glycerine slide, and allowed partially to dry. Stretch the skin carefully but rapidly with needles so as to obtain a very thin layer. The softness of the skin determines the success of the operation. The section should adhere to the slide. Pass through the alcohols down to distilled water. Stain with eosin, azure, or iron hæmatoxylin. G. M. F.

The Dopa Reaction.—G. F. LAIDLAW ("The Dopa Reaction in Normal Histology," *Anat. Rec.*, 1932, **53**, 399–413). A simplified form of Bloch's dopa reaction is described for demonstrating active melanoblasts and myelogenous leucocytes. For stock solution dissolve 0·3 gr. of 3-, 4-dioxyphenylalamine (dopa) in 300 c.c. of distilled water. When dissolved in an alkaline solution and exposed to air this reagent oxidizes spontaneously to a black substance resembling animal melanin. The solution must be kept well corked in a refrigerator and is usable for some weeks or until it blackens. For buffers use Sorensen's M/15 KH_2PO_4 and M/15 Na_2HPO_4, and immediately before cutting sections buffer the stock solution to pH 7·4 by adding 2 c.c. of the former and 6 c.c. of the latter to 25 c.c. of solution. Filter and keep in the ice chest. All glassware must be scrupulously clean. Immediately after death place tissues in 5 p.c. formalin for not over 2–3 hours, freeze, section, rinse rapidly, and place in the buffered " dopa " at 30–37° C. Change after 30 minutes. In about 2 hours the fluid turns reddish and later sepia brown. This marks the end of the reaction; wash immediately in water and mount in balsam. Leucocytes and melanoblasts should be grey or black, melanin itself yellow-brown, and the background colourless or pale grey. G. M. F.

A Modification of Castañeda's Stain for Rickettsia.—P. Lépine ("Simplification de la méthode de Castañeda pour la coloration élective des Rickettsia," *Compt. rend. Soc. de Biol.*, 1933, 112, 17–9). The difficulty of Castaneda's technique is that all methylene blues are not satisfactory. To avoid this difficulty methylene azur II has been substituted for methylene blue. A 1 p.c. solution of methylene azur II is prepared, the dye being dissolved in an 0·5 p.c. aqueous solution of phenol; a 1 p.c. solution of potassium carbonate is also prepared. These solutions keep indefinitely. Before use the following mixture is prepared : Azur II solution, 10 drops; potassium carbonate solution, 5 drops; neutral formalin, 0·5 c.c.; distilled water, 10 c.c. This mixture keeps for some days, but it is preferable to prepare it freshly. Preparations, such as vaginal smears from infected guinea-pigs, must be stained for from 3 to 4 minutes. Wash rapidly in tap water and differentiate for some seconds with a 1 in 1000 solution of safranin from a drop bottle. Wash and dry without blotting. The background is uncoloured, cell protoplasm pale rose, nuclei violet or deep rose. Rikettsia azur blue. The large masses of Rickettsia inside epithelial cells give to the cells an ultramarine blue colour which is easily recognizable. Another method is to allow the azur solution to act for from 5 to 10 minutes and differentiate with a 5 p.c. filtered solution of vesuvin. The cell protoplasm is pale green, nuclei olive green, Rickettsia azur blue. The contrast is less definite but the details are finer. G. M. F.

A Method for Staining Intestinal Protozoa.—H. Tsuchiya ("A Practical Staining Method for Intestinal Protozoa," *J. Lab. & Clin. Med.*, 1932, 17, 1163–4). Make a thin moist film from stool and saline solution. Fix the moist film in Schaudinn's fluid at 60° C. for 10 minutes in the case of trophozoites, for 15 minutes in the case of cysts. Immerse for 10 minutes in iodized 70 p.c. alcohol. Wash in tap water for 1 minute. Mordant in 4 p.c. aqueous iron alum for 20 minutes. Wash for 3 minutes. Drain off excess of water and apply Wright's stain for 1 minute and 5 minutes diluted with distilled water. Wash in tap water for 1 minute. Dehydrate by immersing for 15 minutes in 70 p.c., 95 p.c., and absolute alcohol each. Clear in two changes of xylol for 3 minutes each. Mount in neutral balsam and leave in the incubator till examined. Nuclei of various amœbæ show the nucleoli, chromatin, and linin stained dark blue against a pink background. G. M. F.

A Method of Staining Anthrax Bacilli.—T. van Heelbergen ("Färbung von Milzbrandbazillen für die Praxis nach Foth (etwas abgeänderte Methode)," *Deutsch. Tierärztl Wchnschr.*, 1932, 39, 321–2). Air-dried smears are stained with Giemsa (Holborn) for 2 minutes, rinsed in water, dried between filter paper, passed quickly over a flame, and mounted in cedar oil. *B. anthracis* stains pink, while other bacteria are blue, while if from a fresh autopsy the anthrax bacillus is blue with a pink capsule. The blue staining portion decreases with age so that material examined some days after death shows red capsules that are apparently empty. G. M. F.

Gram's Stain.—M. Rolle ("Ein Beitrag zur Kenntnis der Gram'schen Bakterienfarbung," *Deutsch. Tierärztl. Wchnschr*, 1931, 39, 65–67). The decolorization of Gram positive bacteria is hastened by dissociated acids, alkalies and fats. A picric acid solution may be used instead of Lugol's solution. In describing bacteria it is desirable to indicate the length of time of decolorization. G.M.F.

The Gram Stain and Differential Staining.—M. L. KAPLAN and L. KAPLAN (*J. Bact.*, 1933, **25**, 309–21, 8 text-figs.). Gram-positive bacteria act in a manner suggesting a low permeability to iodine in alcoholic solution. This, combined with the low alcohol solubility of the dye-iodine compound, is probably the cause of dye retention by positives in the Gram test. Methyl alcohol, which decolorizes most Gram-positive organisms almost instantly, does not do so when as little as 0·01 p.c. iodine is added. A series of organisms are placed on a slide : after staining with a 0·5 p.c. solution of crystal violet in 2 p.c. sodium acetate they are treated with Gram-iodine solution, washed and dried, and then placed in small jars containing various concentrations of iodine in methyl alcohol to which 5 p.c. of water was added. Small quantities of freshly prepared and dried calcium carbonate were placed in each jar to ensure neutrality of the methanol. The slides were kept in motion in the solutions for 2 minutes, washed, and counterstained with safranin. Gram-positive bacteria may be differentiated according to their degree of positivity as measured by iodine concentration in methyl alcohol necessary to prevent extraction of iodine and dye from the cell. G. M. F.

A New Staining Method for the Differentiation of Gram-positive Bacteria.—H. DOLD ("Ein neues färberisches Einteilungsprinzip für Bakterien," *Zentrabl. f. Bakt.*, I. Abt. Ong., 1932, **124**, 220–3). The stain is carbol-aniline-green (3 minutes' application) prepared by mixing two parts of saturated alcoholic green (Strassburger's, obtained from Grübler & Co.) with 8 parts of a 1 : 99 mixture of concentrated commercial carbolic acid and distilled water. The stain is filtered and kept 24 hours, then filtered again just before use. Gram's iodine solution is applied for 2 minutes, then decolorization for 5 minutes in a mixture of 1 part 40 p.c. aqueous urea with 9 parts of absolute alcohol ; then counterstaining for 1 minute in a mixture of 1 part saturated alcoholic Bismarck brown and 9 parts of distilled water. While Gram-negative bacteria remain negative three groups of Gram-positive organisms can be distinguished : (i) positive (green) ; (ii) negative (brown) ; (iii) weakly positive (partly green, partly yellowish-brown) ; (iv) variable, being sometimes positive and sometimes negative. G. M. F.

A Rapid Paraffin Embedding Method.—W. L. McNAMARA ("A Rapid Paraffin Technic," *J. Lab. & Clin. Med.*, 1932, **17**, 1162–3). Fix tissue in 10 p.c. formalin ; transfer to 80 p.c. alcohol for 15 minutes ; 95 p.c. alcohol for 45 minutes (forty times as much solution as tissue) ; acetone for 15 minutes ; pour off and add fresh acetone (the same quantity as in the case of 95 p.c. alcohol) for 75 minutes. Place in paraffin (melting-point 54° C.) in the oven for 1 hour. Embed and section. In removing paraffin from the slide use only one xylol bath. Stain by one of the usual staining methods and clear in some essential oil such as clove or organum. G. M. F.

The Specificity of Schiff's Reaction for Aldehydes.—L. LISON ("Sur la spécifité du réactif de Schiff envers les aldéhydes," *Bull. Histol. appl.*, 1932, **9**, 177–95). Feulgen's fuchsin sulphurous acid reaction is by no means specific for aldehydes, for a similar reaction is given by the following substances : aliphatic ketones, pyramidon, amino-oxides, bromine, and catalytic oxidizing agents. It is thus common to all compounds having a double bond between either a carbon and oxygen atom or between two carbon atoms. G. M. F.

A Technique for the Extraction of Anthracotic Pigments from the Sputum.—J. LECLOUX ("Recherches sur l'anthracose pulmonaire. I. Technique d'extraction des pigments anthracosiques de l'expectoration," *Bull. Histol. appl.*,

1932, **9**, 209–12). Purulent anthracotic particles are separated from the saliva and transferred to beakers, covered with a 20 p.c. alcoholic KOH solution and boiled for several minutes. They are covered and kept cool for 24 hours and then, after reheating, placed in a test-tube and centrifuged. The sediment is then washed with distilled water till no trace of KOH remains. Test with phenolphthalein till the pink colour disappears and with silver nitrate to exclude the presence of chlorides. Add 95 p.c. alcohol and pour on to a heavy filter, wash with alcohol, and evaporate. The residue contains all the iron, mineral carbon, some silica, and calcium. Smears of the untreated sputum stained with fuchsin or Giemsa and the inorganic residue are then examined, while the nature of the inorganic particles is determined by histochemical methods.   G. M. F.

The Staining of Intercellular Cement Substance.—D. A. Irwin ("Supravital Staining of Intercellular Cement Substance," *Stain Technol.*, 1933, 8, 36). A selective supravital staining of intercellular cement substance is described. Frog tissue was principally employed, though similar staining was obtained in mammalian tissues. Thin pieces of tissues, e.g., frog skin or omentum, are immersed in 0·1 p.c. solution of indigo tetrasulphonate (La Motte Chem. Prod.) in normal saline for about 10 minutes. They are then quickly rinsed in saline and placed in an 0·2 p.c. solution of methylene blue (*rect. n. Ehrlich* (Grübler)) in normal saline for about 1 minute. After a rapid rinse in saline the tissue is ready for microscopic examination. Permanent preparations can be made by fixation in 10 p.c. ammonium molybdate for 12 hours, washing for 2 hours, dehydrating in absolute alcohol, clearing in oil of wintergreen or xylol, and mounting in Canada balsam. The intercellular cement substance stains a purplish-red and stands out clearly from the nuclei and cytoplasm which are stained a faint blue by the methylene blue. Broad cellular sheets, e.g., pentoneum or subcutaneous lymph sheets of frog skin, are clearly demonstrated.   G. M. F.

Difficulties in the Use of Wright's Stain.—H. J. Conn and L. A. Margolena ("Difficulties encountered in obtaining a Satisfactory Wright Stain," *Stain Technol.*, 1933, 8, 35–6). Four factors are of extreme importance in securing satisfactory results: clean slides or cover-glasses, neutral acetone-free methyl alcohol, a correct reaction of the dilution water, and proper timing of the procedure. The hydrogen-ion concentration is of extreme importance: a stain which gives satisfactory results with human blood may need some manipulation to adapt it to avian blood. For human blood, a phosphate buffer of *p*H 6·5 is often used. Ordinarily a 1-minute application of the alcoholic solution and 1–2 minutes with the diluted stain is recommended. With many specimens of both stains a longer application is necessary, especially with the diluted stain, where 4–6 minutes may be necessary.   G. M. F.

Cytology.

The Nature of the Centrosomes.—E. B. Wilson and A. F. Huettner ("The Central Bodies again," *Science*, 1931, 73, 447–8). Examination of the development of the insect egg (*Drosophila*) shows that the central bodies are neither random granules, nor artificial products of coagulation of the astral rays, nor staining artefacts. In the insect egg obviously they do not serve as blepharoplasts. They are not products of the asters, but are themselves causally concerned in the formation of the asters. In the developing insect egg the central bodies are genetically continuous by division, without the smallest interruption from one cell-generation to another.   G. M. F.

Polyploidy and Metaphase Patterns.—E. B. WILSON (*J. Morphol.*, 1932, **53**, 443–70, 1 pl., 24 text-figs.). A cyst of tetraploid first spermatocyte metaphases is described in the coreid hemipter Archimerus alternatus (Say), all other divisions in the testis being of normal diploid constitution. The striking fact is that in spite of the doubling of their number the chromosomes closely follow the group pattern characteristic of the corresponding normal divisions. In the latter the first metaphase always shows a ring of six autosome bivalents with a single m-chromosome bivalent at its centre and a single univalent X-chromosome lying outside the ring (as in coreids generally). In corresponding tetraploids the numbers are respectively 12, 2, and 2. Three additional interesting features of the tetraploids are : (1) the fact that the two m-bivalents are always lined up end to end to form an axial quadrivalent chain ; (2) that although two X-chromosomes are present (as in the normal female), they are never united to form a bivalent as in that sex ; and, (3) that in the prophases (of which a few are present in the cyst), at least one pycnotic X, or chromosome nucleolus, is present. A critical discussion is offered of the general problem of the mechanism of chromosome movements and groupings, together with a review of recent literature. The conclusion is urged that the chromosomes themselves play an active and important part in these processes, and the possible genetic relations between chromosomes and spindle substance are discussed.   G. M. F.

Spongioplasmatic Structures in the Male Sexual Cells of Tachea nemoralis.—L. MONNÉ ("Les structures spongioplasmatiques dans les cellules sexuelles males chez *Tachea nemoralis*," *Compt. rend. Soc. de Biol.*, 1932, **109**, 428–9, 11 text-figs.). In the spermatocytes the spongioplasm forms a layer which surrounds the nucleus, either closely or at a short distance. In the prophase of the first division the spongioplasm changes its position to surround the spindle in the metaphase in a radial manner. During telophase it divides transversely. During the second division of the spermatocytes the same changes occur. In the young spermatids the spongioplasm forms a layer near the cell membrane, then it contracts to form a compact mass which gradually elongates and lies alongside an elongated mass of mitochondria. The tail of the spermatozoon is composed of elements derived both from mitochondria and spongioplasm.   G. M. F.

Cytological Investigations on the Oogenesis of a Fish.—D. NARAIN (" Cytoplasmic Inclusions in the Oogenesis of *Ophiocephalus punctatus*," *Ztschr. f. Zellforsch. u. mikr. Anat.*, 1930, **11**, 237–43, 8 text-figs.). The Golgi apparatus is seen in the usual juxtanuclear position in the very young oocyte. Later the mass increases in size and resolves itself into very minute Golgi spheres which disperse gradually into the general cytoplasm. The granular mitochondria arise also in the juxtanuclear area ; later they disperse in the cytoplasm. Filamentous and beaded mitochondria appear in the older oocytes. Fatty yolk arises through the agency of the Golgi bodies, either by the swelling of a Golgi granule or by the deposition of new material on the concave side of one or more crescentic Golgi bodies. Albuminous yolk is formed directly or indirectly by mitochrondia.
                                                                        G. M. F.

Molecules in Biological Structures.—O. L. SPONSLER (" The Molecule in Biological Structures as determined by X-ray Methods," *Quart. Rev. Biol.*, 1933, **8**, 1–30, 29 text-figs.). In this review the results of applying to biological structures the methods of X-ray analysis as used for crystals are described. So-called animal cellulose, tunicin, gives an X-ray diffraction pattern which indicates a molecular

structure identical with that of plant cellulose. Human hair, wool, quills, and feathers all give essentially the same X-ray pattern and hence a similar spatial relation of the molecules. G. M. F.

The Shedding of the Nucleus in the Spermatids of Opisthobranchs.—L. Monné ("La mue du noyau dans les spermatides des Opisthobranches," 12 text-figs.). In the young spermatids of *Phyllirhoë bucephala* the nuclear membrane ruptures and forms a cap on the top of the nucleus, then separates from the nucleus and forms a body with pointed ends. The nuclear membrane again forms, is again shed, and becomes lenticular in shape. In the lenticular body are deep-staining granules. In *Tethys leporina* spermatocytes in the dividing state, as well as the spermatids, contain pointed bodies which are formed from the nuclear membrane. G. M. F.

The Immigration of Lymphocytes in the Eggs of Certain Species of Amphibia.—S. Saguchi ("Über die Einwanderung der Lymphozyten in das Ei bei einigen Amphibienarten (*Diemyctylus pyrrhogaster* und *Rana nigromaculata*)," *Zytologische Studien von Professor S. Saguchi*, 1933, 6, 1–23, 5 pls.). In the eggs of frogs and salamanders there are found certain cells which have wandered into the egg through the vitelline membrane and the wall separating the lymphatic spaces of the ovary and the follicle epithelium. The cells are derived from those in the lymphatic spaces of the ovary and are attracted into the egg by chemotoxis. G. M. F.

The Argentophil Structures (so-called Golgi Apparatus) in the Cells of Chick Embryos and Rabbits cultivated in vitro.—S. Saguchi ("Über die argentophilen Gebilde (den sogenannten Golgischen Apparat) in den kultivierten Zellen des Hühnerembryos und des Kaninchens," *Zytologische Studien von Professor S. Saguchi*, 1933, 6, 24–97, 9 pls., 8 text-figs.). An exhaustive account is given of the argentophil structures seen in the various tissues of chick embryos and rabbits cultivated *in vitro*. Cajal's methods were most frequently employed and the argentophil material described in fibroblasts and epithelial cells of the intestine, amnion, mesonephros and liver of the chick, and in fibroblasts, kidney epithelium, bladder, testicle and uterus of the rabbit is regarded as being identical with the Golgi apparatus of normal tissues. The argentophil material, however, varied in type in the same class of cells and is therefore divided into primary and secondary. G. M. F.

Mitochondria and Glucose-glycogen Equilibrium.—E. M. Hall and E. M. Mackay ("The Relation between the Mitochondria and Glucose-glycogen Equilibrium in the Liver," *Amer. J. Path.*, 1933, 9, 205–20, 1 pl.). Animals fed on dried carrots showed in the liver cells in place of the usual short bacilliform rods, long filaments, coarse spherules, and plump rods condensed about the nucleus and to a lesser degree about the cell membrane. Twelve hours fasting in this group produced coarse spherules without definite arrangement in the cytoplasm; many of the spherules appeared to be semi-fluid. Administration of glucose caused hypertrophy and enspherulation of mitochondria with some tendency to paranuclear arrangement. It is suggested that some relation exists between the mitochondria of the hepatic cells and the glucose-glycogen equilibrium. G. M. F.

Arthropoda.

Arachnida.

New Species of the Genus Kongsbergia.—C. WALTER ("Neue Hydracarinen aus dem genus *Kongsbergia* und die Synonymie von *Hjartdalia* Thor und *Kongsbergia* Thor," *Zoologischer Anzeiger*, 1930, **91**, 180–92, figs. 1–12). Gives details of the previously undescribed ♂ of *Kongsbergia largaiolli* (Maglio) and, as new species, *K. ruttneri* and *K. numidica*, the latter being taken by Dr. Chappuis in a river at Tlemcen, Algeria. Author challenges Sig Thor's views as to the relationship of *Kongsbergia* and *Hjartdalia* and adheres to his view that *Kongsbergia* is the nymph of the form described later as *Hjartdalia*.   BM/HNDH

Water Mites as Fish Food.—RUTH MARSHALL ("Watermites from Wyoming as Fish Food," *Trans. Amer. Micro. Soc.*, 1933, **52**, 34–41, pls. 7 and 8). In 1927 Dr. J. W. Scott communicated to the Ecological Society of America a study of trout food based on the examination of some 300 trout, representing four species. About 450 specimens of mites were obtained and these were handed over for identification to Dr. Ruth Marshall, who found, apart from a few specimens awaiting further study, representatives of seventeen species belonging to ten genera. About half of the species found are widely distributed, and of the remainder the following are described and figured : *Sperchon crassipalpis* n.sp., *Atractides occidentalis* n.sp., *A. simulans* n.sp., *Lebertia wolcotti wyomingensis* n.var.   BM/HNDH

Tick Parasites of Porcupines.—W. L. JELLISON ("Parasites of Porcupines of the Genus *Erethizon* (*Rodentia*)," *Trans. Amer. Micro. Soc.*, 1933, **52**, 42–7 ; also published as Paper No. 1095 of the Journal Series of the Minnesota Experiment Station). Following on a study of porcupine parasites undertaken at the University of Minnesota, the author summarizes what is now known of these as Ecto- and Endo-parasites. *Erethizon epixanthum,* from the Rocky Mountains, is noted as an important host of the spotted fever tick *Dermacentor andersoni* Stiles. The only other hosts are the Jack and Snowshoe rabbits.   BM/HNDH

Hydracarina from Java.—C. WALTER ("Hydracarinen aus Java," *Treubia*, 1929, **11**, Livr. 2, 211–73, 48 figs.). Frl. Dr. A. Vorstman, while investigating the Bryozoan fauna of Java, made some collections of fresh watermites, which were submitted to Dr. Charles Walter, Basel, for examination. Walter found representatives of twenty-nine genera, and of these nine species and one form are described as new, viz. *Limnesia octopora, Unionicola armata, U. affinis* forma *unguiculata, Koenikea (Ecpolopsis) testudinata, Rhinophoracarus truncatus, Arrhenurus cornutus, A. harpagopalpus, A. ansatus, A. spinosus, A. asymmetricus.* Walter also revises the Indo-Australasian hydracarine fauna which now covers 132 species ; thirty-three of these are recorded from Java.   BM/HNDH

Halacarids from the U.S.A.—C. WALTER ("Campagne spéologique de C. Bolivar et R. Jeannel dans l'Amerique du Nord (1928)," *Archives de Zoologie Expérimentale et Generale*, 1931, **71**, fasc. 3, 375–81, figs. 1–9 ; also separately as *Biospeologica*, **56**, 6. C. Walter : Halacariens). While the presence of Halacarids in fresh water has been noted from time to time in Europe, the American continent has furnished only a record from Peru. A recent investigation by Messieurs Bolwar et Jeannel into the fauna of Donnelson's Cave, Lawrence Co., Indiana, has brought to light two species, *Soldanellonyx chappuisi* Walter and *S. monardi* Walter, hitherto known from several localities in Europe. A new form, also from the same place as the two preceding, necessitates the creation of a new genus, *Hamohalacarus* with *H. subterraneus* n.sp.   BM/HNDH

Hydracarina from Luzon, Philippine Islands.—C. WALTER ("Hydracarinen von der Insel Luzon, Philippinen," *Phil. J. Sci.*, 1930, **41**, no. 2, 159–67, 3 figs.). The material in this case was collected by Prof. C. F. Baker of the College of Agriculture, Los Baños, Philippine Islands, and sent in 1926 to Dr. P. A. Chappuis. Later it came into the hands of Dr. Chas. Walter, Basel, for examination. One female is referred to *Neumania ambigua* Piers, with which Walter suggests Kœnike's *N. megalommata* may also be associated. *Limnesia bakeri* n.sp. has the genital plates with eight acetabula. A teleiophan which accompanied the male, female, and nymph exhibits four acetabula. *Neumania flagellata* n.sp. has a conspicuous feature in the unusually long fine hair (over 0·3 mm.) at the outer distal end of the fourth segment of the palpus. At the proximal end the hair is fairly stout, becoming very fine towards the distal end. BM/HNDH

O. F. Müller.—K. VIETS ("Otto Friedrich Müller zum Gedächtnis—ein Rückblick und ein Ausblick," *Mikroskopie für Naturfreunde*, 1932, **10**, 1–4, portrait). Gives a short biography of this eminent naturalist. The son of a German State trumpeter, who left Germany for Denmark, O. F. Müller was born in Copenhagen in 1730. After his school education was completed he studied theology, and in 1753 became the tutor to Count Schulin in Frederiksdal, a district which afforded him the material for his "Fauna Insectorum," which, as might be expected of that time, also covered the Acarina. From 1764 to 1767 he travelled extensively in Europe with Count Schulin and later attained some public honours. Müller's classic work is the "Hydrachnæ quas in aquis Daniæ palustribus detexit, descripsit, pingi et Tabulis XI Æneis incidi curavit Otho Fridericus Müller," published in 1781, the first monograph on the watermites. Prior to this—in 1776—he published a more comprehensive work, the "Prodromus," which covered birds, fishes, insects, and worms. Hagen, in his "Bibliotheca," credits Müller with thirteen contributions, but the two mentioned were the principal ones. Viets states that the "piscinæ" in Fredriksdal, where Müller carried on his freshwater investigations, can still be identified. BM/HNDH

Watermites from Abyssinia.—C. WALTER ("Report on the Hydracarina. Mr. Omer-Cooper's Investigation of the Abyssinian Fresh Waters (Dr. Hugh Scott's Expedition)," *Proc. Zool. Soc. London*, 1930, 913–27, 18 text-figs.). Two hundred and five specimens representing seven species were taken from four localities in Abyssinia. All were taken in standing water or marshy ground and at altitudes ranging from about 7500 to 9000 feet. *Limnesia rugosa, Piona crassipes, Arrhenurus procerus,* and *Arrhenurus iniquus* are new species. *Hydrarachna spinosa* Kœn. var. *subtilis* is a new variety of the species recorded by Kœnike from Zanzibar in 1893. The water from which this new variety was taken is recorded as slightly saline. Doubtless other expeditions in time to come will amplify this first record of Abyssinian watermites. BM/HNDH

Saharan Watermites.—C. WALTER ("Mission Saharienne Augiéras-Draper, 1927–1928. Hydracariens," *Bulletin du Museum*, 2e Serie, 1932, **4**, 104–10, 4 text-figs.). Three species of watermites and one oribatid comprise the total collections covered by this report. No new species are recorded, but it is interesting to note that the var. *subtilis* of *Hydrarachna spinosa* recorded from Abyssinia has been found at Bourem on the Niger. A second report by Walter on collections made by Prof. Seurat in the Central Sahara gives more result ("Hydracariens du Sahara Central," *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, 1931, **22**, 331–49, 12 text-figs.). *Limnesia granulosa, Dartia robusta, D. parva, Neumania seurati, Arrhenurus ovatus,* and *A. immodestus* are new species, while a new variety

of *Eylais planipons* is described as var. *magna*. A third species of *Arrhenurus*, which was represented by three nymphs and a teleiophan stage, has not been determined. BM/HNDH

Type and Subgenera of Hydrachna O.F.M.—K. VIETS ("Typus und Subgenera in *Hydrachna* O. F. Müller," *Zoologischer Anzeiger*, 1931, 93, 173–85, 6 text-figs.). Critically reviews the attitude of various writers to this genus. He divides the genus into four subgenera : (1) *Anohydrachna* Thor. (type *H. perniformis* Kœn.) ; (2) *Rhabdohydrachna* nom. nov. for subg. *Hydrachna* Thor. (type *H. comosa*) ; (3) *Diplohydrachna* Thor. (syn. *Odontohydrachna* Thor., *Limnohydrachna* Thor., *Schizohydrachna* Thor. (type *H. globosa*) ; (4) *Hydrachna* s.str. Müll. (syn. *Monohydrachna* Thor.) (type *H. cruenta*). BM/HNDH

North American Watermites.—K. VIETS ("Über Nordamerikanische *Kœnikea-Arten (Hydracarina)*," *Zoologischer Anzeiger*, 1930, 92, 266–72, 8 text-figs.). Came to the conclusion a number of years ago that Wolcotts *Kœnikea concava* 1900 really covered two separate species, a view which later had the support of Lundblad. Receipt of material from Dr. Ruth Marshall led to a reinvestigation, and the North American species are now resolved into two groups (1) with short rostrum, *Kœnikea concava* Wolc. and *K. haldemani* n.sp., and (2) with very long rostrum, *K. wolcotti* nov. nom. *K. marshallœ* n.sp. and *K. spinipes* Wolc. BM/HNDH

Daday's Cingalese Watermites.—C. WALTER ("Revision der von E. von Daday *beschriebenen Hydracarinen* von Ceylon," *Annales Musei Nationalis Hungarici*, 1929, 26, 251–68, 12 text-figs.). Criticizes severely Daday's diagnosis of the material at his disposal from Ceylon. This having come to light again in the Hungarian National Museum at Budapest was placed at Walter's service by Dr. L. Szalay of that institution. The revision has involved several records which rested on the reliability of the original descriptions. *Arrhenurus liberatus* n.sp. represent the ♂, which Daday assumed to be the male of *A. orientalis* (Daday). A form which Viets (1926, *Zool. Jahrb. Syst.*, 52, 390–91) referred to *A. congener* is designated by Walter as *A. discrepans* (n.sp.). BM/HNDH

Genera and Species of Axonopsæ, Mideopsæ, and Arrhenuræ.—K. VIETS ("Über einige Gattungen und Arten der Axonopsæ, Mideopsæ, und Arrhenuræ (Hydracarina)," *Zoologischer Anzeiger*, 1931, 93, 33–48, 14 text-figs.) Discusses the orthography of Piersig's genus *Krendowskia*, which was founded on the name of a Russian worker, the transliteration of the last syllable of the Russian name being a stumbling block to some later workers. Comments are made on the species of this genus and of *Geayia*. *Krendowskia convexa similis* is a new subspecies. Roqueellinæ is a new subfamily referred to A-Thienemanniidæ. *Africasia* (Africa et Asia) is a new genus to embrace *Mundamella arrhenuripalpis* and *M. cataphracta*. Viets, while admitting that *Arrenurus* rests on an erroneous transcription of the Greek in 1834 and that *Arrhenurus* is correct, nevertheless, giving weight to zoological rules, reverts to *Arrenurus* as the proper name of the genus, from which the anomaly arises that the family and generic names have the first two syllables " Arren- " while the superfamily and subfamily have the corresponding syllables " Arrhen." BM/HNDH

Acercus pistillifer var. stylatus Lundblad.—O. LUNDBLAD (" Zur Kenntnis der wenig bekannten Hydracarine *Acercus pistillifer* var. *stylatus* Lundblad," *Zoologischer Anzeiger*, 96, 292–98). Describes at some length this varietal form of

which only a preliminary account appeared in 1924. Author suggests that *Acercus dudichi* described by Szalay in 1929 may be identical either with this variety or with the type form. BM/HNDH

Anatomical Features of Arrhenurus.—O. LUNDBLAD (" Über die Anatomie von *Arrhenurus mediorotundatus* und die Hautdrüsen der *Arrhenurus-Arten*," *Zeitschrift für Morphologie und Ökologie der Tiere* (Abt. A der *Zeitschrift für Wissenschaftliche Biologie*), 1930, **17**, 302–38, 26 text-figs.). Describes in considerable detail his studies on the internal and external anatomy. The concluding section deals with homosexuality in the genus, which the author succeeded in photographing. BM/HNDH

Notes on Watermites.—K. VIETS (" Bemerkungen zur Kenntnis der Wassermilben," *Zoologischer Anzeiger*, 1931, **93**, 208–27, 10 text-figs.). Discusses a number of points of interest to the systematist. He proposes to use the term *Hydracarina* in an ecological sense to embrace all acarids which are found living in water, irrespective of their taxonomy. In addition to the forms usually recognized as belonging either to the fresh or salt waters (Hydracaridæ and Halacaridæ) others such as *Halarachne* or the oribatid *Hydrozetes*, *Scutovertex* or *Halozetes* or the sarcoptid *Hyadesia* (*lentungula*) would be embraced. He proposes to substitute Latreille's Hydrachnellæ for Müller's Hydrachnæ, as more suitable in a systematic sense. The genus *Hydryphantes* comes under review, ten of its species being reduced to synonyms of *H. crassipalpis* and *H. dispar*. It is surprising that the creation of so many species, each resting on a single specimen collected at the same time from the same locality, did not earlier suggest the possibility of aberration from recognized forms. *Lebertia* is severely criticized and the subgenera reduced to five. *Atractides* also is dealt with and Thor's *Rusetria* re-established with subgeneric rank. *Rusetriella* is a new subgenus. New subfamilies are Euthyasinæ, Eupatrinæ, Mamersinæ, Neumaniinæ. *Mesobatella serratiseta* Viets is the type of a new subgenus *Mesobatella*. *Megapus separatus* is proposed as nom. nov. for a reference provisionally in 1926 to *M. coriaceus*. BM/HNDH

East African Watermites.—O. LUNDBLAD (" Scientific Results of the Cambridge Expedition to the East African Lakes, 1930–1. 8. *Hydracarina*," *J. Linnean Soc., Zoology*, 1933, **38**, 277–96, 13 text-figs.). Records a small but interesting collection made by Dr. Worthington's party while carrying out investigations on the East African lakes. The new species, *Hydrachna inæquiscutata* rests on only two specimens, one a male and the other a female, the anterodorsal shield of the latter being remarkably varied from that of the former, whence, presumably, the specific name. The author provisionally refers this species to subgenus *Monohydrachna* until more material is available for the study of the anterodorsal shield, when the status of the female as belonging to this species can be more satisfactorily established. The author appears to place more weight on the subcutaneous margins of the epimera than do other workers. The shape of the stigmata as a help to separating species is a new point, but whether that can be depended on is another matter, at least until it is known that that shape is constant within a species. A male, female, and nymph is referred to *H. bisignifera f. worthingtoni*, forma nova, in honour of the leader of the expedition. *Bargena mirifica*, described by Kœnike in 1893 from material from Zanzibar, and later enlarged by Viets, has here received a critical revision. *Piona caligifera* also has a new var. *worthingtoni*. The remainder of the material has been identified with previously described species, occurring for the most part in Africa. Types and allotypes have been placed in the British Museum. BM/HNDH

Mites from Eastern Siberia.—IWAN SOKOLOW (" Beiträge zur Kenntnis der Hydracarinenfauna des Ussuri-Gebietes. I. Hydracarinen der stehenden Gewässer," *Zoologische Jahrbücher* (Abt. f. *Syst. Ökol. u. Geogr. der Tiere*), 1931, **61**, H. 4, 397–522, pls. 9 and 10, 91 text-figs.). Records the results of collections of watermites in the Maritime Province north of Vladivostock and east of the Amur and Ussuri rivers. The expedition, which was led by Dr. A. W. Martynow and in which the author took part, set out in the summer of 1927 to study the almost unknown evertebrate fauna of the waters, both standing and flowing. For the present, the results only concern the standing-water fauna. Seventy-six species are recorded, of which twenty-two are described as new. A few of the species are cosmopolitan, while rather more than half may be classed as palearctic ubiquists. Three have hitherto been limited to Bengal and China. BM/HNDH

Watermites of the North German Lakes.—K. VIETS (" Quantative Unter-suchungen über die Hydracarinen der norddeutschen Seen," *Archiv. für Hydro-biologie*, 1930, **22**, 1–71, 23 text-figs., 33 tables in text and 3 folding). Reports on extensive collections of watermites made by Dr. J. Lundbeck in fifty lakes in North Germany. Attention was directed to the appearance of mites on the lake bottoms and also to the vertical and horizontal distribution of the different forms in the lakes. As will be gathered from above, much of the work is tabulated. *Lebertia alata lucinensis* n.f., *Piona rotunda disjuncta* n.ssp., *P. trisetica bituberosa* n.ssp. are described as new. (" Tiefenverteilung einiger Hydracarinen in nord-deutschen Seen," *Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie*, 1932, **5**, 276–82, 2 text-figs., 2 tables in text.) Viets summarizes here very shortly the principal results covered by the preceding report. BM/HNDH

Protozoa.

Cultivation of Balantidium.—M. TANABE and K. KOMADA (" On the Culti-vation of *Balantidium coli*," *Keijo J. Med.*, **3**, 1932, 383, 2 figs.). A successful culture of *Balantidium coli* from the pig was obtained in a medium consisting of inactivated horse serum (1 part) and Fränkel's solution (16 parts) which is composed as follows : Aq. dest. 1000 c.c., asparagin 4 gms., ammonium lactate 6 gms., K_2HPO_4 2 gms., NaCl 5 gms., at $pH = 6$; to this mixture are added two to three loopfuls of sterile rice starch. The ciliate was maintained in this medium for more than a year at 37° C. C. A. H.

Balantidium from Rat.—M. NAGAHANA (" The Morphology and Culture of a *Balantidium* found in the Wild Rat (*Mus norvegicus* Erxl.)," *Keijo J. Sci.*, **3**, 1932, 492, 2 pls.). A ciliate, identified as *Balantidium coli*, was found in the rat (*Mus norvegicus*). The parasites were numerous in the cæcum and in the large and small intestines, invading the mucous and submucous tissues. The ciliates were cultivated in Tanabe and Komada's medium for 327 days (164 generations) at 37° C. The cultural forms retain their infectivity to white rats. C. A. H.

Embadomonas Cogeneric with Retortamonas.—D. H. WENRICH (" The Relation of the Protozoan Flagellate, *Retortamonas gryllotalpœ* (Grassi, 1879) Stiles, 1902, to the Species of the Genus *Embadomonas* Mackinnon, 1911," *Trans. Amer. Micr. Soc.*, **51**, 1932, 225, 2 pls., 2 text-figs.). A comparative morphological study of a number of intestinal flagellates belonging to Grassi's genus *Retortamonas* (1879) has convinced the author that it is cogeneric with and, therefore, has priority over Mackinnon's genus *Embadomonas* (1911), which becomes a synonym of the

former genus. A detailed description is given of *R. gryllotalpœ*, with notes on some other members of the genus. The close similarity between *Retortamonas* and *Chilomastix* is pointed out and a new family name, Retortamonadidæ, is proposed to include these two genera and to replace Embadomonadidæ Alexeieff (1917).

C. A. H.

New Parasitic Flagellate from Beetle.—Q. M. GEIMAN ("*Retortamonas caudacus* (n.sp.), an intestinal flagellate from a beetle larva, Gyrinidæ sp.," *Trans. Amer. Micr. Soc.*, **51**, 1932, 219, 1 pl.). Description of a new flagellate, *Retortamonas caudacus* sp.n., parasitic in the intestine of a beetle larva belonging to the Gyrinidæ (*indet.*). The flagellate has the generic characteristics of *Retortamonas* Grassi (1879) and *Embadomonas* Mackinnon (1911–15), differing from the other species in the body form, nuclear structure, and the cyst. C. A. H.

Host-specificity of Coccidia.—E. R. BECKER ("Cross-infection Experiments with Coccidia of Rodents and Domesticated Animals," *J. Parasitol.*, **19**, 1933, 230). Description of cross-infection experiments conducted with a view of ascertaining the host-specificity of some coccidia of the genus *Eimeria*, using mainly the Norway rat and its coccidia, *E. miyairii* and *E. separata*. The results were as follows : The rat is not susceptible to infection with *E. magna* of the rabbit, *E. scabra*, *E. debliecki* and *E. perminuta* of the pig, *E. faurei* of the sheep, *E. smithi* of the ox, *E. caviæ* of the guinea-pig, and *E. tenella* and *E. maxima* of domestic fowl. The rat coccidia, on the other hand, are not infective to mice, rabbits, guinea-pigs, and young squirrels. It is, however, possible to infect the American cotton-tail rabbit, *Sylvilagus floridanus*, with *E. magna* of the Belgian hare, *Lepus cuniculi*. [This is not surprising in view of the fact that *E. magna* (or *E. stiedœ*) is common to both rabbits and hares in Europe.] C. A. H.

Marine Infusoria from Japan.—Y. HADA ("Report of the Biological Survey of Mutsu Bay, 24. The Pelagic Ciliata, Suborder Tintinnoinea," *Sci. Rep. Tohoku Univ.* (4 ser.), **7**, 1932, 553, 26 figs.). A morphological study of heterotrichous ciliates belonging to the suborder Tintinnoinea, collected in Mutsu Bay (Pacific Ocean). The record contains thirty-four species belonging to twelve genera and eight families. The description is preceded by a key for the identification of genera, the diagnosis of these and of the species described being based on the structure of the lorica exclusively. The following are new forms : *Tintinnopsis tenuis*, *T. conglobata*, *T. directa*, *Codonellopsis limosa*, *C. orientalis*, *Parafavella faceta*, *Proplectella expolita*, *Tintinnus exigua* spp.n. C. A. H.

Trichonymphid Flagellates of Termites.—H. KIRBY, JN. ("Flagellates of the Genus *Trichonympha* in Termites," *Univ. Calif. Pub. Zool.*, **37**, 1932, 349, 12 pls., 4 text-figs.). The author has studied practically all the known species of the hypermastigid flagellates of the genus *Trichonympha* occurring in termites, and the present is a revised comparative account of these and of six new species, bearing on their systematics, morphology, and distribution in 111 species of termites. The structure of the various species is described in some detail, especially that of the parasites from *Termopsis*. The following species are new : *Trichonympha collaris*, *tabogæ*, *quasilli*, *subquasilli*, *lighti*, *sœpiculœ* spp.n. A general account of the morphology of the genus is given, the detailed observations on the separate species being summarized in the diagnoses. There is also a synoptic key to the known species and a host-list showing the names of the termites, the localities from which they were collected, and the presence or absence of *Trichonympha*. Ten entozoic micro-organisms of undetermined nature were found in the flagellates.

C. A. H.

Saline-water Protozoa.—H. KIRBY, Jn. ("Two Protozoa from Brine," *Trans. Amer. Micr. Soc.*, **51**, 1932, 8, 2 pls.). Description of a flagellate and a ciliate from Californian salt pools with a salinity of 15 p.c. The flagellate is similar to *Trichomastix salina* from a similar habitat in Europe, but, in the author's view, both belong to the genus *Tetramitus*, to which they are referred under the name *Tetramitus salinus* (Entz, 1904). For the ciliate a new species, *Rhopalophrya salina* sp.n., is created. It differs from other species of the genus in size and form. A morphological description and diagnoses of both protozoa, illustrated by two plates of figures, is given. C. A. H.

Diagnosis of the Dysentery Amœba.—B. K. SPECTOR ("A Comparative Study of Cultural and Immunological Methods of Diagnosing Infections with *Entamœba histolytica*," *J. Prevent. Med.*, **6**, 1932, 117). The use of the cultural method, in preference to direct fæcal examination, is advocated for the diagnosis of amœbic dysentery. The following culture medium was employed : Slants, prepared from three parts of inactivated Wassermann-negative human serum and one part of physiological saline (0·85 p.c. NaCl), covered with a mixture of one part of sterile inactivated Wassermann-negative human serum and six parts of either normal saline or Ringer's solution. Complement fixation, skin, and precipitin tests were found to be inadequate for the detection of *Entamœba histolytica* infections. C. A. H.

Intestinal Flagellate from Macaque.—D. H. WENRICH ("A Species of *Hexamita* (Protozoa, Flagellata) from the Intestine of a Monkey (*Macacus rhesus*)," *J. Parasitol.*, **19**, 1933, 225, 8 figs.). Description of an intestinal flagellate, *Hexamita* sp., from a rhesus monkey, *Macacus rhesus*, differing only in minor details from *Octomitus* (= *Hexamita*) *pitheci* of Cunha and Muniz (1929). This parasite is 4–6μ long, 2–4μ broad ; with flagella about twice as long as the body, and vesicular nuclei. C. A. H.

Coccidia from Quail.—C. VENARD ("Helminths and Coccidia from Ohio Bobwhite," *J. Parasitol.*, **19**, 1933, 205). The examination of sixty-seven American quail, the Ohio Bobwhite *Colinus virginianus virginianus*, revealed an infection with the following three species of coccidia : *Eimeria dispersa* Tyzzer, 1929, *E. tenella* Railliet & Lucet, 1891, and *E. acervulina* Tyzzer, 1929, of which the last two have not previously been reported from this bird. *E. tenella* was transmitted from the bobwhite to the chicken. C. A. H.

Cultivation of the Hamster-trypanosome.—L. NATTAN-LARRIER and B. NOYER ("Les cultures du trypanosome du hamster (*Trypanosoma rabinowitchi*)," *C. R. Soc. Biol.*, **112**, 1933, 523). The author has succeeded in cultivating *Trypanosoma rabinowitchi*, parasitic in the blood of the hamster (*Cricetus frumentarius*), in the NNN medium made up, on one hand, with the blood of rabbit, on the other, with the blood of rat. Morphologically the cultural forms did not differ in any respect from those of the rat-trypanosome. That the forms cultivated actually belonged to the hamster-trypanosome and did not originate from trypanosomes introduced into the medium with the blood of rats and rabbits was established in a series of control cultures ; flagellates only appeared in those tubes which had been inoculated with the blood of infected hamsters, while none appeared in those made up with rat or rabbit blood, without the addition of hamster-blood. The hamster-trypanosome developed more rapidly in the medium made with rabbit's blood, and growth was generally better at 37° C. than at 18–22°. C. A. H.

Zone Fossils from Texas.—HELEN J. PLUMMER ("Foraminiferal Evidence of the Midway-Wilcox Contact in Texas," *Univ. Texas Bull.*, **3201**, 1933, 51–68, pl. v). Describes and figures three new species, *Ammobaculites expansus*, *A. midwayensis*, and *Spiroplectammina rossæ*, which are persistent and common fossils in the uppermost layers of the highly fossiliferous Midway formation. As such they are of value in marking the line of contact between that formation and the immediately overlying Wilcox strata, which contain very few fossils and were apparently laid down under conditions very unfavourable for foraminiferal life.

<div align="right">A. E.</div>

Middle Eocene Foraminifera from New Zealand.—F. CHAPMAN (" On a Rock containing *Discocyclina* and *Assilina* found near Mount Oxford, South Island, New Zealand." " On the Occurrence of the Foraminiferal Genus *Miogypsinoides* in New Zealand," *Rec. Cant. Mus.*, 1932, **3**, 483–93, pl. 61–3). The first paper describes the fauna of the *Discocyclina* bed underlying the Oxford " Chalk," including the genera *Assilina*, *Heterostegina*, *Discocyclina* (two new species), and *Asterocyclina*. The age of the bed is distinctly Eocene and the presence of *Assilina* indicates a basal horizon of the Lutetian (Middle Eocene). The *Discocyclinæ* prove littoral continuity of New Zealand with the East Indies as far back as the Middle Eocene. The second paper records and figures a new variety *nitidula* of *Miogypsinoides dehaarti* (Van der Vlerk), a species already known, from Lower Miocene strata in the East Indies, New Guinea, etc., and hence of interest as proof of land or coastal connection between New Zealand and the East Indies as recently as Lower Miocene times.

<div align="right">A. E.</div>

Upper Cretaceous Foraminifera from Canada.—R. T. D. WICKENDEN (" New Species of Foraminifera from the Upper Cretaceous of the Prairie Provinces," *Trans. Roy. Soc. Canada*, 1932, ser. 3, **26**, sect. 4, 85–92, pl. 1). Describes and figures twelve new species, making with previous publications twenty-one new species described in recent years from the Upper Cretaceous of the Prairie Provinces of Canada. The number of new species is not great in proportion to the total number of nearly one hundred species found, considering that the area from which they came is far from any other where work on the Foraminifera has been carried on. The predominance of arenaceous species in the majority of the faunas is believed by the author to be due to the shallowness and low salinity of the Cretaceous sea in this area. Among the new species is *Miliammina manitobensis*, of particular interest as the first record of this genus in the fossil condition. *Miliammina* was described in this Journal (1930) from recent specimens from South Georgia and the Antarctic, where it is generally distributed, and its presence, indicating cold water conditions, would sufficiently explain the preponderance of arenaceous species in these deposits.

<div align="right">A. E.</div>

Miocene of Florida.—J. A. CUSHMAN and G. M. PONTON (" The Foraminifera of the Upper, Middle and Part of the Lower Miocene of Florida," *Florida State Geol. Surv.*, Bull. 9, 1932, 1–147, pls. 1–17, map, 2 tables). A large number of samples from various localities indicate that the deposits were laid down on a constantly varying shore-line, the changes in which affected the oceanic currents and the bathymetric conditions. At no time was a depth attained sufficient to support a characteristic deep-water fauna. The climate at one time was tropical or subtropical, then it became cooler, and subsequently semitropical again. These various zones have their characteristic species, lists of which are given. The percentage of recent species varies greatly in the different beds with an average of over 60 p.c. for the whole formation, indicating that conditions have remained

rather uniform in the Florida and West Indies regions since Miocene times. Over 200 species and varieties are listed, seventeen of which are new. The illustrations are admirable. A. E.

New Eocene Foraminifera.—J. A. CUSHMAN ("New Foraminifera from the Upper Jackson Eocene of the South Eastern Coastal Plain Region of the United States," *Cont. Cush. Lab. For. Res.*, 1933, no. 127, 1–21, pls. 1–2). Contains descriptions and excellent figures of thirty-three new species and seven new varieties published by permission of the Director of the U.S. Geological Survey, in anticipation of a report on this formation which has been delayed in publication. It is stated that many of the species have a wide range in the American Upper Eocene. A. E.

American Cretaceous.—J. A. CUSHMAN ("The Foraminifera of the Annona Chalk," *J. Palœont.*, 1932, **6**, no. 4, 330–345, pls. 50–1). The fauna of this chalk, as well as of the Upper Cretaceous series in general of Texas and related regions, are very similar to those of equivalent formations in Europe ; and many of the species are identical. No new species are described. Many familiar Cretaceous forms are excellently illustrated. The abstractor takes this opportunity of referring to the frequent absence in American publications of definite information as to the locality of the subject material. It is not stated where Annona is, though from the context it is presumably in Arkansas. It is not mentioned in *The Times* atlas, and, however well known the place may be to American geologists, some further information would be desirable for the benefit of non-American students. A. E.

Foraminifera of Fenland Clays.—W. A. MACFADYEN ("The Foraminifera of the Fenland Clays at St. Germans, near King's Lynn," *Geol. Mag.*, **70**, April, 1933, 182–91). The sequence of deposits at St. Germans consists of five clays interbedded with four peats, the whole apparently post-Glacial. Fourteen samples were collected from the clays, all containing Foraminifera. Forty-one of the species obtained are indigenous, five are derived from the Chalk, and twelve from the Kimmeridge Clay. Nearly all the indigenous species are forms tolerant of brackish water, while species intolerant of such conditions are almost lacking. From this fact and from the presence of peat fragments in the clays it is concluded that the clays are of brackish water origin. The presence of micaceous silt in some clays, accompanied by foraminiferal species less tolerant of brackish water, is taken as evidence of occasional ingress of estuarine water. The general conclusion is that the clays were deposited under brackish-water conditions ; that they are lagoonal or lacustrine clays, but the basins were not completely cut off from the sea. A. E.

Trimorphism in Textularia sagittula (Defrance).—E. LACROIX ("Nouvelles recherches sur les spécimens méditerranéens de *Textularia sagittula* (Defrance)," *Bull. de L'Instit. Ocean.*, 1933, no. 612, 1–23, 9 text-figs, 7 tables). The paper is in the nature of a reply to certain criticisms by J. Hofker (1932) on the author's earlier paper (1929) dealing with this species. He has examined and measured a very large number of specimens from dredgings made off Cap Martin, Monaco, in depths 50–60 metres, with a fauna resembling that of the material from the Gulf of Naples examined by Hofker. Full details of his methods and the results are given. His conclusions are : (1) Both the form A and the form B of the species have an initial planospire ; (2) the planospire presents constant differences in the number of chambers which allow form A to be readily distinguished

from form B ; (3) the formulæ governing the size and frequency of the form B laid down in his previous paper are correct. The present work has further convinced the author that (a) the size of the protoculum in microspheric specimens is subject to variation, and (b) there is a certain amount of evidence in favour of the existence of trimorphism in the Textulariidæ. A. E.

Renaming the " Challenger " Foraminifera.—H. E. THALMANN (" Nomenclator (Um- und Neubenennungen) zu den Tafeln 1 bis 115 in H. B. Brady's Werk über die Foraminiferen der Challenger-Expedition, London, 1884," *Eclog. geol. Helvet.*, 1932, **25**, no. 2, 293–312). Brady's monograph on the Challenger Foraminifera with its admirable plates by Hollick has been the standard work in all countries since its publication in 1884. But subsequent work and changes in classification have caused many of his identifications to become obsolete, and many new species have been created on the strength of his figures. The author attempts a renaming of Hollick's plates in the light of recent research and publications, and as such the paper will be of value to students, though not all the identifications can be accepted as authoritative. A. E.

The Genus Pleurostomella.—H. E. THALMANN (" Additional Notes on the Genus *Pleurostomella* Reuss 1860," *Eclog. geol. Helvet.*, 1932, **25**, no. 2, 313–4). Adds seven species and varieties described by Seguenza in 1880 from the Lower Pliocene of Reggio, Calabria, Italy, and three species described by Grzybowski in 1896 from the Lower Tongrian (Oligocene) of the Carpathians, to the lists assembled by Cushman and Harris. (See " Notes on the Genus *Pleurostomella* " in *Cont. Cush. Lab. Foram. Res.*, 1927, **3**, 128–34, pl. 25, and " Additional Notes on the Genus *Pleurostomella*," *loc. cit.*, 1927, **3**, 156, pl. 28.) Since the publication of these two papers only a single species appears to have been erected, *P. vicksburgensis* Howe 1930 from the Byram marl (Oligocene) of Mississippi. (*J. Palæont.*, **4**, 331, pl. 27, fig. 5.) A. E.

Corrections of Nomenclature.—H. E. THALMANN (" *Nonion Jarvisi* nom. nov. and *Trochammina Kellettæ* nom. nov.," *Eclog. geol. Helvet.*, 1932, **25**, no. 2, 312–3). Substitutes these new names for *Nonion cretaceum* Cushman & Jarvis 1932, and *Trochammina peruviana*, Cushman & Kellett 1929, the specific names having been respectively preoccupied by Schlumberger (*Nonionina cretacea* 1899) and W. Berry (*Trochammina peruviana* 1928). A. E.

Distribution of Hantkenina.—H. E. THALMANN (" Die Foraminiferen-Gattung *Hantkenina* Cushman 1924 und ihre regional-stratigraphische Verbreitung," *Eclog. geol. Helvet.*, 1932, **25**, no. 2, 287–92). Arranges stratigraphically the records of the various forms referable to this genus, which is confined to the Upper Cretaceous, Eocene, and Lower Oligocene on both sides of the Atlantic. A. E.

The Genus Pavonina.—W. J. PARR (" Notes on Australian and New Zealand Foraminifera. No. 2. The Genus *Pavonina* and its Relationships," *Proc. Roy. Soc. Victoria*, 1933, **44**, pt. 1 (n.s.), 28–31, pl. 7). Only one species, the genotype *P. flabelliformis* d'Orbigny, has been recorded from the Indo-Pacific region, to which it is confined. It is widely distributed but uncommon. There are several Australian records both recent and fossil, but it is unknown in New Zealand. In the course of examination of washings from the Tertiary of Victoria, the author has observed the genus at several localities. Two species occur, the genotype and a new species described and figured as *Pavonina triformis* which has previously been confused with *P. flabelliformis*. It differs in having a triserial stage preceding the series of alternate chambers and resembles the genus *Reussia* in its early

development. It is confined to the Oligocene and Miocene, while *P. flabelliformis* occurs only in the Lower Pliocene, post-Tertiary, and Recent. From the study of the two species it appears to be the progenitor of *P. flabelliformis*, and its triserial structure places *Pavonina* in the Buliminidæ near the genera *Reussia* and *Chrysa-*

<div align="right">A. E.</div>

Fossil Foraminifera in Dredged Material.—W. A. MACFADYEN (" Fossil Foraminifera from the Burdwood Bank and their Geological Significance," *Discovery Reports (Cambridge Univ. Press)*, 1933, **7**, 1–16, 2 text-figs.). Many fossil Foraminifera were noted by Heron-Allen and Earland in a dredging from the Burdwood Bank, to the south of the Falkland Islands, and their occurrence so far from land was considered sufficiently important for attention by a geologist. The specimens with further material from the R.R. ships *Discovery* and *William Scoresby* have been submitted to a critical examination by Dr. Macfadyen, who lists thirty-four species in all. No macroscopic fossils were found. Many of the species have no value by themselves as age-markers, as they range from Cretaceous to Recent. Four species, however, *Rzehakina epigona, Spiroplectammina spectabilis, Pseudotextularia globulosa*, and *Cyclammina elegans* stand out as definite indication of uppermost Cretaceous age. Some others are also typically Upper Cretaceous but may not be confined to such strata. The fauna as a whole presents a rather deep-water habitat and has many features in common with the Upper Cretaceous and Tertiary beds of the West Indian region. Upper Cretaceous strata are known to exist in Southern Patagonia and Tierra del Fuego, and similar strata are found in Graham Land in the Antarctic. It is considered that the Burdwood Bank beds are a continuation of those exposed on Tierra del Fuego and Staten Island, and a part of the Andean folding hitherto known under the ill-named title of the " South Antillean Arc." It is proposed to rename it the " Scotia Arc," since it surrounds the newly named Scotia Sea. This Scotia Arc of folding is continued on the line of the Shag Rocks, South Georgia, Clerke Rocks, South Sandwich Islands, South Orkney Islands to the South Shetlands and Graham Land. The contour of the sea bottom as plotted out by H. F. P. Herdman (Report on Soundings taken during the *Discovery* Investigations, 1926–1932, by H. F. P. Herdman, M.Sc., in *Discovery Reports (Cambridge)*, 1932, **6**, 205–236, pls. 45–47, 7 charts), from the very numerous echo soundings made by the *Discovery* Expedition definitely fits in with this line of the Scotia Arc, and so confirms the geological theory. This is an excellent and admirably reasoned paper, and, after feeling for so many years that Foraminifera were only useful as zone-markers for oil-seekers, it is quite refreshing to learn that they have also served a purpose in confirming the speculative geology of Suess.

<div align="right">A. E.</div>

Ultramicroscopic Viruses.

Herpetic Infection of the Chorio-allantoic Membrane.—J. R. DAWSON, Jn. (" Herpetic Infection of the Chorio-allantoic Membrane of the Chick Embryo," *Amer. J. Path.*, 1933, **9**, 1–5, 2 pls.). The chorio-allantoic membrane of the chick embryo is susceptible to infection with a strain of herpes simplex virus which is innocuous to adult chicks of the same breed. The microscopic lesions of these membranes are similar to the herpetic lesions of mammals. A peculiar change in ectodermal cells is described, characterized by enormous enlargement of the nucleus and by a partitioning of it by delicate trabeculæ into compartments which are filled by small, uniform, faintly stained basophilic granules. G. M. F.

Cellular Inclusions in Lethargic Encephalitis.—J. R. DAWSON, Jn. (" Cellular Inclusions in Cerebral Lesions of Lethargic Encephalitis," *Amer. J. Path.*, 1933, 9, 7–16, 2 pls.). In a case of what was clinically encephalitis lethargica there were found in the nuclei of certain ganglion cells and neuroglial cells inclusion bodies not unlike those caused by herpes simplex. The inclusions were most numerous in the cells of the cortex. In some cells there were also cytoplasmic masses. Two other cases of encephalitis lethargica did not exhibit these inclusions, while animal inoculations with material from all three cases produced no demonstrable infection.   G. M. F.

Microincineration of Intranuclear Inclusions.—E. V. COWDRY (" The Microincineration of Intranuclear Inclusions in Yellow Fever," *Amer. J. Path.*, 1933, 9, 149–164, 2 pls.). In preparations of uninjured liver cells of the monkey made by microincineration, the nuclear ash corresponds closely in position with materials seen in the fresh cells, as well as in fixed and stained preparations. The nucleolus —easily recognizable in fresh cells by its position, shape, and refractive index—is found to be amphophilic in fixed and stained specimens and to yield a very heavy, sharply localized ash after incineration. Chromatin, which is not visible as such in the still living cell but can be observed after fixation and staining in the form of basophilic substance scattered in the nucleoplasm and applied to the nuclear membrane, also leaves a mineral residue which is rather less dense. Marked alterations also occur in nuclei reacting to the virus of yellow fever and in which nuclear inclusions are developing. The changes in size and shape of the nuclei in the basophilic chromatin and in the nucleolus can be followed with precision almost as great as in stained specimens, since parallel modifications occur in the mineral residue. The nuclear inclusions, pathognomonic of the disease, although conspicuous features of the fresh and fixed and stained preparations, cannot be studied in incinerated specimens, for they yield little or no ash. They therefore differ from the nucleoli and basophilic chromatin in the same way that Scott (*C. R. Acad. Sc.*, 1930, **190**, 1073) observed in the case of nuclear inclusions caused by the submaxillary virus in guinea-pigs.   G. M. F.

Erythroleucosis.—H. L. RATCLIFFE, J. FURTH, and C. BREEDIS (" Studies on the Pathogenesis of Erythroleucosis," *Amer. J. Path.*, 1933, 9, 165–84, 2 pls.). Under the influence of a filterable agent, the basophile erythroblasts of the sinusoidal capillaries of the marrow undergo unrestricted multiplication. The erythroblasts thus formed failed to mature. They crowd out all other elements of the marrow, secondarily invade the circulation, and accumulate in the capillaries of internal organs, where they continue multiplication. Fowls inoculated with material containing erythroleucotic cells show growth of these cells in the blood stream and organs at a time when erythroblasts have only partly filled the capillary bed of the marrow. In fowls injected with the cell-free material the blood does not contain these immature cells till the marrow is almost completely filled by them. With erythroleucosis thrombocytes in the blood stream are at first increased, later much diminished or absent. With disturbances of erythrogenesis formation of thrombocytes is inhibited.   G. M. F.

Virus Pneumonia in Animals.—H. A. McCORDOCK and R. S. MUCKENFUSS (" The Similarity of Virus Pneumonia in Animals to Epidemic Influenza and Interstitial Bronchopneumonia in Man," *Amer. J. Path.*, 1933, 9, 221–52). Vaccine virus infected into the lungs of rabbits can incite two different types of reaction depending on its concentration. A strong virus tends to produce a hæmorrhagic œdematous consolidation and irregular areas of necrosis with hæmorrhage that

resembles infarcts. Polymorphonuclear leucocytes infiltrate the necrotic tissue if the animal survives. This acute reaction has been termed hæmorrhagic virus pneumonia. A dilute virus, on the other hand, calls forth a proliferative cellular lesion which is termed interstitial virus pneumonia, in which the walls of the bronchi, the alveoli, and the blood vessels become thickened due to an infiltration that consists principally of mononuclear cells. The lesions of hæmorrhagic virus pneumonia in rabbits are similar to the hæmorrhagic and œdematous lobular consolidation with foci of necrosis found in the lungs of individuals dying a few days after the onset of symptoms of epidemic influenza. The cellular infiltration of interstitial virus pneumonia in rabbits resembles the interstitial accumulation of cells seen in the interstitial bronchopneumonia that so frequently accompanies influenza, measles, and whooping cough in man. G. M. F.

BOTANY.

GENERAL.

Cytology.

A Diploid Offspring of a Haploid Œnothera.—J. A. LELIVELD (" Cytological Observations on the Diploid Offspring of a Haploid *Œnothera franciscana*," *La Cellule*, 1932, **41**, 281-9). The plant studied was a diploid *Œ. franciscana* type of the F₂ of a self-fertilized haploid which itself arose in the cross *Œ. franciscana* × *Œ. longiflora*. Special attention was given to diakinesis and later stages in microsporogenesis. Regular pairing in diakinesis is rare in spite of the homozygosity and homogamety of the type. Irregularities are greater than in the original *Œ. franciscana*. Interlocking of pairs in twos is frequent, and three or more pairs may be interlocked. Chains of four to six chromosomes were also seen. Linkages and interlockings become diminished at the approach of metaphase and the chromosomes tend to pair up as separate pairs. Anaphase and telophase are regular. The work supports the view that the peculiarities are independent of the genetical structure of the type and the cytological structure of the plant is largely inherent to the species. J. S.

Somatic and Meiotic Chromosomes of Galtonia.—F. H. SMITH (" The Structure of the Somatic and Meiotic Chromosomes of *Galtonia candicans*," *La Cellule*, 1932, **41**, 243–63). In the somatic cells each anaphase chromosome contains two chromonemata visible (in anther cells) as two intertwining spirals. In early prophase only a single chromonema is observed. This results from the close association of the two seen in the anaphase chromosomes. As prophase advances ' the two chromonemata separate, and at late prophase each splits to form two sister chromonemata. These are observed more completely separated in the metaphase chromosomes of anther cells than in root-tip cells. In meiosis, each single leptotene strand represents the closely associated halves of a single chromosome. Parasynaptic pairing of these strands is initiated at the beginning of synizesis, during which it is completed. After synizesis the four chromatids of a pair of chromosomes are fused into a single chromonemal strand surrounded by a matrix. In early diakinesis a single chromonema is found in each chromosome of a pair. At any time up to early anaphase this chromonema becomes separated into two sister strands. The sister chromonemata become completely separated and embedded in separate matrices in anaphase. At heterotypic telophase the sister chromonemata are only in contact at the point of spindle fibre attachment. The homotypic division is essentially similar to the somatic. J. S.

A Trisomic Œnothera.—K. M. GOODWIN (" A Trisomic *Œnothera*," *Ann. Bot.*, 1933, **47**, 89–100). The cytology of a trisomic (= 15 chromosome) form derived from *Œ. Lamarckiana cana* is described in detail. The types of chromosome configuration at first metaphase include (1) a chain of thirteen and a ring bivalent ; (2) chains of seven and five chromosomes, together with a ring bivalent

and a univalent; (3) a chain of ten chromosomes with a ring-and-rod bivalent, together with a ring bivalent; (4) branched chains of four and five chromosomes. Various examples of chiasmata are described and figured. At first anaphase a 7–8 distribution most usually occurs followed by the formation of tetrads containing 7–7 and 8–8 chromosomes. Irregularities are observed due to (1) the presence of incompletely terminalized chiasmata and the consequent failure of chromosomes to reach the poles in time to be included in the interkinetic nuclei; (2) irregular behaviour of the univalent. These irregularities produce gametes with varying contents. The author supports the view that *Œnothera* is parasynaptic, that crossing-over occurs, that terminalization of the chiasmata so formed must occur in order that viable gametes shall be produced.   J. S.

A New Haploid Œnothera.—D. G. CATCHESIDE (" The Chromosomes of a New Haploid *Œnothera*," *Cytologia*, 1932, 4, 68–113). Morphological and cytological characters are described for the new haploid *Œnothera* which arose in one family of the F_1 of *Œ. blandina* × *Œ. novæ-scotiæ*. The haploid is derived by parthenogenesis from the diploid *Œ. blandina* n = 7. Eighty per cent. of the pollen mother-cells of the haploid show seven univalents; in the remaining 20 per cent. various bivalent, trivalent, and quadrivalent configurations occur. Corresponding multivalents have been seen in the diploid. Chromosome associations in the haploid prove the presence of reduplicated segments in the chromosome complement. Evidence is given proving that chiasma formation is associated with and is a direct result of cytological crossing over. The significance of the reduplications in relation to segmental interchange, translocation, and the origin of a self-perpetuating ring mechanism is discussed.   J. S.

Cytology of Timmia.—L. M. SCHEUBER (" A Cytological Study of *Timmia cucullata*," *La Cellule*, 1932, 41, 147–62). The resting nucleus of an embryonic cell contains one large nucleolus surrounded by a faintly staining chromatin-linin network. Near the nucleolus are found small deeply-staining bodies which vary in number, size, and shape, and are apparently not of nucleolar origin. Twelve chromosomes are present in the gametophyte nuclei. There is no evidence of the presence of a heteropycnotic chromosome. Details of fertilization are given. The somatic nuclei of the sporophyte are much larger than the gametophytic nuclei. Varying numbers of extranucleolar bodies occur round the nucleolus in both somatic and spore mother-cells. One such body is regularly present at the spireme stage. At the heterotypic division twelve chromosome pairs are observed. The author concludes that " heteropycnosis," as described by Heitz (1928) to be general in mosses, does not occur in *Timmia cucullata*.   J. S.

Somatic Chromosomes in Lilium tigrinum.—HSU-SIANG (" Structure of Somatic Chromosomes in *Lilium tigrinum*," *La Cellule*, 1932, 41, 165–78). The somatic chromosomes in *L. tigrinum* are composed of two chromonemata embedded in an achromatic matrix. The formation of daughter chromosomes occurs as prophase advances by the chromonemata straightening out and becoming parallel in the matrix. This is the separation of the two chromonemata which first become observable in the previous prophase and which persist throughout the ensuing mitotic cycle. At late prophase, when the daughter chromosomes are formed, the definite duality of each chromonema is observed. The exact stage at which splitting of the chromonema occurs is not known, nor is the stage of splitting of the achromatic matrix. Two possible causes of the latter process are suggested: (1) that a repulsive force is developed between the chromonemata, thus creating a

tension on the matrix causing it to split; (2) that the ratio between the mass of chromonematic to non-chromonematic substance may be effective. J. S.

Chromosomes in Nicandra physaloides.—E. K. JANAKI-AMMAL (" Chromosome Studies in *Nicandra physaloides*," *La Cellule*, 1932, **41**, 89–110). Somatic and meiotic chromosomes were studied in *Nicandra physaloides* var. *immaculata*, and *N. physaloides* var. *typica*, and no cytological differences found between the varieties. The chromosome numbers are n = 10, 2n = 20. In the resting nuclei of somatic cells homologous chromosomes are found associated in pairs each containing a single spiral chromonema. Details of mitosis are described. Synizesis is a constant feature of meiosis as observed in microsporocytes. The thread which emerges from synizesis is longitudinally split with the two halves closely twisted about each other. The mode of chromosome pairing is parasynaptic followed by the formation of chiasmata, which leads to a wide range of variation in configuration of the bivalents. At metaphase the chromosomes are much condensed and the spiral structure obscured. Details of division are described up to tetrad formation. The chromosomes of *Nicandra* are of at least five different lengths, the organization resembling that in *Datura* and suggesting a close phylogenetic relationship between the two genera. J. S.

Chromosome Types in Disporum.—N. HASEGAWA (" Comparison of Chromosome Types in *Disporum*," *Cytologia*, 1932, **3**, 350–68). Somatic and meiotic chromosomes were studied in *Disporum pullum, D. sessile, D. smilacinum*, and *D. smilacinum* var. *ramosum*. In all, the chromosome number was found to be n = 8, 2n = 16. One form of *D. sessile* showed 2n = 24 in root tips. The chromosomes were classified according to length, relative positions of constrictions, and occurrence of satellites. A special method is devised for measuring the true length of chromosomes with foreshortening; this technique is described in detail. The sixteen somatic chromosomes of each species and the variety examined fall into eight types which are fully illustrated. The chromosome types of *S. smilacinum* and its variety *ramosum* are very similar. Five of these types are also found constantly in *D. pullum* and *D. sessile*, but two or three types are slightly different in the sets of the three species. It is suggested that the changes in size and shape of certain chromosomes may have occurred during the phylogenetic courses of the species. J. S.

Pollen Abortion in Hybrids.—D. KOSTOFF (" Pollen Abortion in Species Hybrids," *Cytologia*, 1932, **3**, 337–9). Abortive pollen was studied in species hybrids of *Secale* and *Nicotiana*. The abortion of pollen in these hybrids seems to be due to the retardation of the meiotic processes and of the nuclear division in the pollen regardless of whether the pollen has the complete haploid complement or not. In the *Secale* hybrids the pollen nuclei were all seen to have seven chromosomes, *i.e.* the whole haploid set. In seven *Nicotiana* species hybrids, one cause of retardation of the nuclear divisions is the increase of cytoplasmic viscosity which results on hybridization. J. S.

Ferox-Quercifolia-Stramonium Triangle in Datura.—A. D. BERGNER and A. F. BLAKESLEE (" Cytology of the *Ferox-Quercifolia-Stramonium* Triangle in *Datura*," *Proc. Nat. Acad. Sci.*, 1932, **18**, 151–9). Three inbred tester races were used in making interspecific hybrids involving *Datura Stramonium, D. quercifolia*, and *D. ferox*. Both *D. ferox* and *D. quercifolia* are " B " and " Peruvian " types. They show, in common with races of *Stramonium* from Peru, two types of segmental interchange between non-homologous chromosomes. The

B race has the *Stramonium* tester chromosomes 1·2 and 17·18 modified to 2·17 and 1·8. The Peruvian type has the *Stramonium* tester chromosomes 11·12^{12} and ^{2}121·22 modified to 11·21^{21} and ^{12}12·22. A previously unknown type of interchange is partly identical in *ferox* and *quercifolia*. In the latter the *Stramonium* tester chromosomes 7·8^{8} and 19·20^{20} are modified to 7·20^{20} and 19·8^{8}. In *ferox* a further interchange between the 7·20^{20} and 15·16^{16} chromosomes has formed the 7·20^{16} and 15·16^{20} chromosomes. In back-crosses of the *Stramonium-ferox* hybrid this configuration has given rise to two new configurations, both of which are explainable on the assumption of crossing-over between the homologous regions of the 7·20^{16} and 19·20^{20} chromosomes. Such crossing-over is detectable in the hybrid because in terms of the *Stramonium* tester the 7·20^{16} chromosome is composed of parts of these three chromosomes 7·8^{8}, 15·16^{16}, and 19·20^{20}. The heterozygous condition of the hybrid makes possible the incorporation of the newly formed chromosomes into viable gametes.   J. S.

Anatomy and Morphology.

Lignification of the Cell Wall, with Special Reference to Salix alba.— A. KÜNEMUND (" Die Entstehung verholzter Lamellen untersucht besonders an *Salix alba*," *Bot. Archiv.*, 1932, 34, 462–521). The physico-chemical constitution of the developing lignified lamella was studied by means of staining with the substantive metachromatical stain oxamin blue 4R. This substance is composed of colour micelles of different sizes, the larger being blue and the smaller red to yellow. The staining process consists of an ultra-filtration of the mixture through the membrane, the resulting colour being an indication of the size of the pores in the membrane. The material investigated consisted of cross-sections of shoots of *Salix alba* var. *vitellina* f. *pendula*, and the results of the staining process showed that the lignified lamellæ are loosely constructed at first, later becoming more compact. The colouring of the lamellæ is dichroitic, the pleochroism increasing as lignification proceeds. The chemical nature of the material was studied by four methods : fluorescence analysis, chloride of zinc-iodine, phloroglucin, and Mäule's reagent. The results of this second series of tests agreed with each other and with those of the first series. Thus the lignifying lamellæ of growing wood are fluorescent with medium intensity which gradually increases, while the intensity of the staining reactions also increases as lignification proceeds. The conclusion is that lignification is a gradual process proceeding through intermediate stages of impregnation to a final condition of concentration.   B. J. R.

Wood Structure of Sarcosperma paniculatum.—H. F. MARCO (" The Wood of *Sarcosperma paniculatum*," *Trop. Woods*, 1933, 33, 1–4). In Bentham and Hooker's *Genera Plantarum* two species of *Sideroxylon* and one of *Reptonia* were segregated into a new genus *Sarcosperma* (family Sapotaceæ, near *Lucuma*). Subsequently a monotypic family, Sarcospermaceæ, was proposed to include the species of this genus, of which nine are now recognized. *S. paniculatum*, which is widely distributed in the Malay Archipelago, was at one time considered to be a new species of *Diococalyx* of the family Myrsinaceæ. The wood structure of this species, which is described, is so different from that of the Myrsinaceæ that it would probably never occur to a wood anatomist to relate it to that family. It is similar to certain of the Sapotaceæ such as *Lucuma* and *Chrysophyllum*, the outstanding difference being in the wood fibres, which are thin-walled with conspicuously bordered pits, whereas in the Sapotaceæ they are characteristically thick-walled and the pits are simple.   B. J. R.

Wood Structure of Rhabdodendron and Duckeodendron.—S. J. RECORD ("The Woods of *Rhabdodendron* and *Duckeodendron*," *Trop. Woods*, 1933, **33**, 6–10). *Rhabdodendron amazonicum* has been referred to the Rutaceæ, the Rosaceæ-Chrysobalanoideæ, and the Phytolaccaceæ. The wood is characterized by the anomaly of successive development of secondary groups of wood and bast, which indicates affinity with the Phytolaccaceæ. The position of *Duckeodendron cestroides* in the Borraginaceæ appears to be incorrect in view of the anatomical structure of the wood, which is characterized by large, widely separated, open radial canals. It is considered that the genus has affinities with the Apocynaceæ, and this conclusion is supported by examination of the bark structure.   B. J. R.

Wood Structure of Guarea Thompsonii.—D. NORMAND ("Le Bois de *Guarea Thompsonii*, succedané du Bossé," *Rev. Bot. Appl. et d'Agric. Trop.*, 1933, **13**, 23–30). Sapwood whitish, clearly differentiated from the heartwood, which is pinkish-orange, turning brown on drying, and possesses a cedar-like scent. Rays invisible to the naked eye, irregularly arranged, variable in size, 350–600μ in height, 30–40μ in width, one or two cells wide, subhomogeneous, six to seven per millimetre. Parenchyma visible in transverse section as concentric wavy bands only partially surrounding the vessels and alternating more or less regularly with bands of fibrous tissue. Chambered crystal cells sometimes occur between the parenchyma cells and the fibres. Vessels scarcely visible to the naked eye, containing gummy deposits, fairly uniform in distribution, five to eight per square millimetre, slightly variable in size, mean diameter 80–120μ, solitary or in radial groups of two or more. Vessel segments with simple perforations and numerous very small bordered pits 3μ in diameter. Fibres septate, in radial seriation, 20–24μ wide, average length 1400–1600μ. The wood differs from that of *Guarea cedrata* in the greater abundance of parenchyma and the smaller number of vessels and rays.   B. J. R.

Structure of some Scented Woods.—C. R. METCALFE ("The Structure and Botanical Identity of some Scented Woods from the East," *Bull. Misc. Inf.*, *Kew*, 1933, **1**, 3–15, 4 pls.). Considerable confusion exists concerning the botanical identity of various scented woods passing under the local name of Calambac or similar names. The paper describes the structure of nine of these woods with a list of their names and notes on their sources and uses. The species dealt with are drawn from seven genera of five families as follows : *Aquilaria Agallocha* Roxb., *A. malaccensis* Lamk. and *Gonostylus bancanus* (Miq.) Baill. (Thymelæaceæ), *Excæcaria africana* Muell. Arg., *E. Agallocha* L. and *Euphorbia antiquorum* L. (Euphorbiaceæ), *Cordia fragrantissima* Kurz (Boraginaceæ), *Mansonia Gagei* J. R. Drumm. (Sterculiaceæ) and *Cinnamosma fragrans* Baill. (Canellaceæ). The descriptions are illustrated by photomicrographs.   B. J. R.

Identification of Chinese Hardwoods.—Y. TANG ("Timber Studies of Chinese Trees. III. Identification of some Important Hardwoods of South China by their Gross Structures, I," *Bull. Fan Mem. Inst. Biol.*, 1932, **3**, (17), 253–338, 18 pls.). The timbers described in this paper represent ninety-four species belonging to seventy-one genera and thirty-four families. The general properties and macroscopic features of the woods are described and illustrated by photomicrographs of cross-sections at a magnification of sixteen times. The Tsing-lin mountain range in Shensi is generally recognized as the main boundary between northern and southern China for botanical purposes. Species found north of this range are designated as belonging to North China, and those found south of it, to South

China. The key to the genera of Chinese woods, included in the present paper, is enlarged to include all the species from both North and South China which have been described by the author. **B. J. R.**

Problems in Identifying the Wood of Mesozoic Coniferæ.—I. W. BAILEY ("The Cambium and its Derivative Tissues. VII. Problems in Identifying the Wood of Mesozoic Coniferæ," *Ann. Bot.*, 1933, **47**, 145–58, 2 pls.). It is shown that the distinctions between the two contrasted types of tracheary pitting, namely, "alternate" and "opposite," are not infallible diagnostic criteria. The two types, together with intermediate types, occur in the genus *Cedrus*. The presence or absence of the so-called Rims or Bars of Sanio is shown to be due to the distribution of intercellular material between the walls of adjoining tracheids. The indiscriminate use of these structures in the identification of fossil woods is unsound, as it rests on the fallacious inference that they are preserved in visible form under all conditions of fossilization. The distribution of the resin canals in the adult wood of *Keteleeria Davidiana* is of the same type as occurs in *Protopiceoxylon* and *Pinoxylon dacotense*. Such hypothetical transitional genera as *Protocedroxylon*, *Protopiceoxylon*, *Planoxylon*, *Thylloxylon*, etc., fall within the range of structural variability of *Cedrus*, *Keteleeria*, and other genera of the Pinaceæ. If they are to be classified as Protopinaceæ or Araucariopityeæ, then so must fragments of the wood of *Cedrus*, *Keteleeria*, and other genera of the Pinaceæ. It is suggested that the wisest procedure in dealing with woods of obvious Pinaceous affinities is to refer them, for the present, to one of the following form genera, rather than to attempt to classify them under extant or hypothetical extinct genera : (1) *Pinoxylon*, for woods within the range of *Pinus*. (2) *Piceoxylon*, for woods within the range of *Picea*, *Larix*, and *Pseudotsuga*. (3) *Cedroxylon*, for woods within the range of *Keteleeria*, *Pseudolarix*, *Cedrus*, *Tsuga*, and *Abies*. **B. J. R.**

Anatomy and Development of the Floral Organs of Bougainvillæa glabra. —D. C. COOPER ("The Anatomy and Development of the Floral Organs of *Bougainvillæa glabra*," *Amer. J. Bot.*, 1932, **19**, 814–22, 2 pls.). The young peduncle is first recognized during the development of the inflorescence of *Bougainvillæa glabra* Choisy as a small rounded mass of cells in the axil of a leaf. Three bract primordia arise from the edge of the flattened apex of this group of cells. The flowers can at first be recognized as club-shaped masses of meristematic cells in the axils of the partially developed bracts. The perianth tube is produced by the growth of the perianth primordia, which broaden at their bases until they unite. The base of the single primordium of the carpel, which arises at one side of the growing tip, broadens laterally until it encircles the apex of the growing pedicel. Microsporogenesis is normal, and four microspores are produced. The mature pollen grains have a thick exine and intine which serve to retain the hemispherical shape of the grains. No two-celled pollen grains were observed, nor were any pollen grains seen to germinate. An apical hypodermal cell becomes the archesporial cell which divides to form a primary parietal cell and the macrospore mother-cell. The ovule, which is at first upright, subsequently bends so as to take a position that is intermediate between the campylotropous and anatropous types. The surfaces of the bracts and perianth lobes are covered with multicellular glandular hairs, and raphides are present in the bracts,.perianth lobes, and ovary wall. **C. R. M.**

Anatomy of the Leaf of Panicum palmifolium.—T. P. AMIDEI ("The Anatomy of the Leaf of *Panicum palmifolium*," *Bull. Torrey Bot. Club*, 1932, **59**, 491–9, 3 figs.). The leaves of *Panicum palmifolium* Willd. (*Chætochloa palmifolia* (Willd.) Hitchc. & Chase) differ from most grass leaves in possessing a sheath, petiole,

ligule, and blade. The upper surface of the blade is covered with fine hairs and the margin is serrate, but its most striking feature is the series of oblique longitudinal folds which are especially prominent when the plant has insufficient moisture. In young plants the petiole may be 4 inches long, but in the later formed leaves it is much shorter or even lacking. The ligule consists of long hairs. The structure of the blade at different stages of development was studied in order to discover the mechanism by which the leaf folds and unfolds with changes of moisture. The author considers that the initial unfolding is caused by the development of abnormally large epidermal cells (termed bulliform cells) situated at the bases of the grooves. On the other hand, the folding and unfolding of an adult leaf are thought to be due to the hygroscopic sensitiveness of the bulliform cells. Although the venation is apparently pinnate, this is not really so. The veins do not unite where they are connected with the midrib, but retain their individuality as separate strands. However, at the base of the blade a few veins were found to unite with one another instead of entering the midrib separately. The juvenile leaf, like that of other grasses, is folded when in the bud, but becomes flattened when it emerges. The folds of the leaf do not appear until the bulliform cells develop.   C. R. M.

Formation of Callus Knots on Apple Grafts.—J. E. SASS ("Formation of Callus Knots on Apple Grafts as related to the Histology of the Graft Union," *Bot. Gaz.*, 1932, **94**, 364–80, 4 pls.). Gall-like outgrowths at the junction of stock and scion are common on apple trees in nurseries. These are frequently due to a bacterial pathogen (*Pseudomonas tumefaciens* Sm. & Town.), but it is becoming increasingly clear that they are not always pathogenic in origin. The present investigation is concerned with the non-pathogenic type of gall. The scion wood was from the variety "Wealthy" and the stocks were from one-year-old French crab seedlings. The formation of callus first becomes apparent in the bark. In some preparations early activity was to be seen in the cambium, but it was found generally that the cambium took little part in the production of the callus. The primary cortex of the scion and the older secondary phloem of the stock and scion may produce most of the callus. The periderm, on the other hand, takes no part in the formation of the callus. Callus may be formed only from limited areas or from nearly the whole of the cut surface of the bark. If the cut surfaces of the stock and scion are not kept clean, areas of dead cells are formed and serve as barriers which prevent effective contact between stock and scion. However, sooner or later more deeply seated tissues usually proliferate and rupture the dead cells. In other instances extensive and more permanent inactive areas seem to retard callusing. Fungi may also play a part in preventing the union of stock and scion. In a healthy graft the spongy callus cells mingle, and are compressed by growth until the respective cells of stock and scion become indistinguishable. When a union has been completed, outward proliferation is prevented by the outer tangential cells of the callus becoming suberized. The medullary ray cells of the wood do not proliferate during the first year. The callus cells adjacent to the original cambium become active after a union has been effected as described above, and form a definite cambium bridge between stock and scion. The complete cambial layer sheathing the union subsequently lays down a vascular cylinder, which comprises the second annual ring of the tree. Unsatisfactory unions were found generally to be due to the use of stocks and scions of very different diameters. In poorly matched grafts excess marginal callus of undifferentiated cells is first produced, but later on a well-defined cambium zone is formed in it, the cells of which divide tangentially and produce an excess of marginal callus. The author

believes that in bad grafts the accumulation of the products of photosynthesis, due to the lack of vascular continuity, may be the cause of the continued enlargement of the callus knots. C. R. M.

Pollen from the Upper Cretaceous Dysodil of Banke, Namaqualand.— F. KIRCHEIMER (" On Pollen from the Upper Cretaceous Dysodil of Banke, Namaqualand (South Africa)," *Trans. Roy. Soc. S. Africa*, 1932, **21**, 41–50, 2 pls., 6 figs.). A description of fossilized pollen grains from the Upper Cretaceous Dysodil of Banke, Namaqualand. The most interesting fact about them is that in spite of their bad preservation, they were recognized as being unrelated to the pollen of any present-day representatives of the flora of the same district. One type of grain was similar to that found in *Corylus* and *Myrica*. (The pollen in these two genera can be distinguished only with difficulty.) This is of interest on account of the occurrence of *Myrica* in Cape Province at the present day. Two of the types of pollen had wings, and are thought to have belonged to one of the Abietineæ. The pollen of Angiosperms was much more abundant than that of Coniferæ, indicating that Angiosperms were the dominant plants at the time when the Dysodil was formed. C. R. M.

Identification of Fossil Angiosperms by the Characters of their Vegetative Organs.—M. E. ODELL (" The Determination of Fossil Angiosperms by the Characteristics of their Vegetative Organs," *Ann. Bot.*, 1932, **46**, 941–63, 6 figs.). When the fossilized remains of Angiosperms are found without fruits or seeds it has become customary to identify them from their vegetative characters. For this purpose such characters as the shape and size of the epidermal cells, the outline of the lateral wall of the epidermal cells, the nature of the subsidiary cells (if present), the size, structure, and number of stomata per unit area have been used. In the present paper the dangers underlying the use of such characters are set forth. The author studied the form, venation, and epidermis of foliage leaves of 170 species of present-day Angiosperms from a wide range of families, and found that the characters mentioned above, as well as the nature of the glandular or clothing hairs (where these were present) were so variable, not only within individual families but also within genera or even species, that in her opinion no reliance can be placed on them for diagnostic purposes. Moreover, instances are cited of leaves having a similar form, venation, or epidermis in unrelated families. A special study was made of the Campanulaceæ, Compositæ, Malvaceæ, and Scrophulariaceæ with a view to discovering leaves in which were combined the same form, venation, and epidermal structure as in leaves from unrelated families. Four examples of this were found, viz.: (1) Between *Campanula latiloba* A.DC. (Campanulaceæ) and *Inula salicina* L. var. *denticulata* (Borb.) Javorka (Compositæ). (2) Between *Kitaibelia vitifolia* Willd. (Malvaceæ) and *Aster furcatus* Burgess. (Compositæ). (3) Between *Celsia cretica* L. (Scrophulariaceæ) and *Aster Glenhi* F. Schmidt (Compositæ). (4) Between *Veronica virginica* L. var. *japonica* Steud. (Scrophulariaceæ) and *Actinomeris squarrosa* Nutt. (Compositæ). The author believes that these results obtained from an examination of living Angiosperms doubtless hold good also for fossil Angiosperms. The paper ends with a bibliography of eighty-one titles. C. R. M.

Embryology of Solanum melongena L.—P. N. BHADURI (" The Development of Ovule and Embryo-sac in *Solanum melongena* L.," *J. Ind. Bot. Soc.*, 1932, **11**, 202–24, 1 fig., 6 pls.). The archesporial cell arises in the hypodermis and functions as the megaspore mother-cell. More than one archesporial cells are sometimes present. The archesporial cell divides twice and gives rise to a linear tetrad of

four megaspores. Three of these degenerate, the chalazal one alone developing into a normal embryo-sac with the usual eight nuclei. The antipodals degenerate before fertilization. The embryo-sac is surrounded by a single layer of tapetal cells. Details of the behaviour of the chromosomes at meiosis are given.

<div align="right">C. R. M.</div>

Root Structure of Enhydra fluctuans Lour.—G. P. MAJUMDAR (" Hetero-archic Roots in *Enhydra fluctuans* Lour.," *J. Ind. Bot. Soc.*, 1932, **11**, 225–7, 1 pl.). *Enhydra fluctuans* Lour. grows in moist soil in Bengal, but spreads over the surface of adjoining pools of water. In water, three types of root arise from a single node. The thin roots are always triarch, whilst the thicker ones are either tetrarch or pentarch.

<div align="right">C. R. M.</div>

Embryology of Jute.—I. BANERJI (" The Development of the Embryo-sac and Fertilization in Jute," *J. Ind. Bot. Soc.*, 1932, **11**, 228–40, 19 figs., 1 pl.). The ovules, which arise from the margins of the placenta as blunt papillate processes, assume an anatropous position during their development. The archesporial cell, which is situated in the hypoderm, divides periclinally to form a primary wall cell and megaspore mother-cell. Two megaspore mother-cells were sometimes observed, but only one develops. A linear tetrad of four megaspores is formed, of which only the chalazal one develops. The mature embryo-sac contains two synergids, the egg, two polar nuclei, and three antipodals. Experiments on the germination of the pollen *in vitro* and *in vivo* are described. Pollen-tubes were not usually observed at the micropyle until 6 hours after pollination, although, in a few instances, they were seen in the micropyles 3 hours after pollination. No branched pollen-tubes were observed. One of the synergidæ disintegrates when the pollen-tube enters the embryo-sac, but the other persists until the time of fertilization. Fertilization is slow, and the first division of the egg does not take place until 12–16 days after pollination. Degenerating ovules were sometimes seen inter-spersed amongst normal ones after pollination. The author believes that fertiliza-tion does not take place in these imperfect ovules. The first division of the egg is transverse ; a proembryo is developed consisting of three or four cells. The distal cell (and sometimes the cell above it) divides longitudinally. The octant stage is reached later, and the dermatogen is cut off by periclinal walls. The periblem and plerome become differentiated subsequently. The suspensor is very short and consists generally of three cells.

<div align="right">C. R. M.</div>

Systematic Anatomy of the Cucurbitaceæ.—E. GHOSH (" On the Micro-structure of the Stems of some Bengal Cucurbitaceæ with reference to its Value in Taxonomy," *J. Ind. Bot. Soc.*, 1932, **11**, 259–70, 1 pl.). The anatomy of the stems of fourteen species of Cucurbitaceæ was studied in order to determine how far anatomical characters may have a taxonomic value. The species were *Benincasa cerifera* Savi, *Citrullus vulgaris* Schrad., *Coccinia indica* Naud., *Cucumis Melo* L., *C. sativa* L., *Cucurbita Pepo* DC., *Lagenaria vulgaris* Ser., *Luffa acutangula* Roxb., *L. ægyptiaca* Mill., *Momordica Charantia* L., *M. cochinchinensis* Spreng., *Trico-santhes Anguina* L., *T. dioica* Roxb., and *T. palmata* Roxb. Only stems in which no secondary growth had occurred were studied, and four specimens of each species from different localities were examined. Most of the paper consists of a key showing the nature of the anatomical variations in the species studied. The type of characters used are the general contour of the stem, the shape of the epidermal cells, the presence or absence of hairs and their nature if present, the amount and distribution of the collenchyma, the thickness of the pericycle, and the nature and number of the vascular bundles. The genera were found to be

most easily distinguished by differences in the arrangement of the collenchyma and pericycle, whilst the characters and arrangement of the bundles are more useful in separating species. The author believes that extensive work on comparative anatomy may enable many disputed taxonomic and phylogenetic questions to be settled. C. R. M.

Anatomy of Indian Halophytes.—D. P. MULLAN (" Observations on the Biology and Physiological Anatomy of some Indian Halophytes," *J. Ind. Bot. Soc.*, 1932, **11**, 285–302, 8 pls.). The paper consists of descriptive notes on the habitat, anatomy, and biology of the following species : *Sonneratia apetala* Ham., *Ægiceras majus* Gaertn., *Acanthus ilicifolius* Linn., *Avicennia officinalis* Linn., *A. alba* Blume. C. R. M.

Anatomy of the Alismataceæ.—F. J. MEYER (" Beiträge zur Anatomie der Alismataceen II. Die Blattanatomie von *Rautanenia Schinzii* Buchenau," *Beihefte Bot. Centralbl.*, 1932, **50**, 54–63, 5 figs.). Amongst the more salient anatomical features of the leaf of *Rautanenia Schinzii* may be mentioned : The epidermal cells of the petiole are elongated and polygonal, but their shape varies at different levels in the petiole. The epidermal cells of the lamina are also polygonal, but isodiametric on the upper surface, although somewhat elongated on the lower side. The stomata are provided with two laterally placed subsidiary cells, which on the petiole form fairly deep air chambers at the entrances to the stomata. The guard cells on the lamina, on the other hand, are only slightly sunken. There are cavities in the petiole, separated from one another by diaphragms composed of thin-walled cells. The homogeneous mesophyll of the lamina consists of spongy parenchyma. There are no connections between the bundles in the petiole, but those in the lamina are feebly connected. Latex tubes occur in the petiole. In the petiole calcium oxalate crystals are present in the cells surrounding the lacunæ, but in the lamina similar crystals are present in the mesophyll. These anatomical differences between the lamina and the petiole permit the laminar and petiolar regions of a ribbon leaf to be distinguished from one another. *Rautanenia Schinzii* was at first described as *Echinodorus Schinzii*, but it was afterwards, for morphological reasons, placed in a separate genus The author believes that the anatomical features are in support of this separation, and furthermore favours the suggestion (also at first expressed on account of the external morphological features) that it may be closely related to *Burnatia enneandra*. C. R. M.

Value of the Type of Mechanical Tissue and Crystalline Deposits as Systematic Characters in the Genus Allium.—W. CHARTSCHENKO (" Verschiedene Typen des mechanischen Gewebes und der kristalinischen Ausbildungen als systematische Merkmale der Gattung *Allium*," *Beihefte Bot. Centralbl.*, 1932, **50**, 183–206, 23 figs.). As the result of an extensive investigation of the characters of the calcium oxalate crystals present in the bulbs of fifty-two species of the genus *Allium*, the author concludes that the nature of these bodies is of value in studying the systematics of the genus. It was found possible to recognize fifteen types of crystalline inclusion, all of which are fully described and figured. These different types of crystal are characteristic of the various sections of the genus which have been established from considerations of external morphology. Moreover, the closer the relationship between the various sections of the genus the greater is the similarity of the crystals. In contradistinction to the conclusions of Jaccard and Frey (*Vierteljahrschrift der Naturforschende Gesellschaft in Zurich*, 1928, **73**) the author did not find that the type of crystals varies according to differences in the habitats of the various species. A study of the mechanical

tissue in the bulbs was also made. However, it was found that although a given species is frequently characterized by the nature of its mechanical tissue, the variations in this tissue are of little systematic value. They correspond rather to the ecological characteristics of the various species. C. R. M.

Anatomy of Pine Needles.—V. FIESCHI ("Anatomie de la feuille chez les pins maritimes," *Trav. Laborat. Forestier de Toulouse*, 1, art. 18, 1–18, 4 figs.). The anatomy of the needles of *Pinus maritima* L. was studied in order to determine whether it is possible to distinguish the different varieties of this species microscopically. Material from different localities was examined, and the anatomy was studied in transverse sections of the needles taken at the apex, middle, and base respectively. The author believes that two distinct types within the species can be distinguished, one of which never has more than two resin canals at the extreme base of the needle, whilst the other always has in the corresponding region a number of canals greatly in excess of two. These two types are referred to as the Atlantic and Mediterranean respectively. However, the distinction can be recognized in trees transferred from one locality to another, which is thought to indicate that the difference is not due merely to environmental conditions. The author believes the Mediterranean and Atlantic types to be separate species. Within the Mediterranean species no anatomical difference could be found by which the well-marked Corsican and Narbonne forms could be distinguished. These forms are, therefore, to be regarded as Jordanian species. C. R. M.

Morphological Value of the Cladode in the Rusceæ.—L. JOYEUX ("Valeur morphologique du cladode chez les Ruscées," *Archiv. de l'Instit. Bot. de l'Université de Liège*, 1928, 7, 1–94, 13 pls.). The paper begins with an historical review of the various theories concerning the morphological value of the cladode of the *Rusceæ* which have from time to time been put forward. Then follow two chapters, in the first of which the author's present researches are described in detail, whilst the second is concerned with general theoretical considerations based on the author's observations. The external morphology and anatomy of *Ruscus aculeatus* L. are described in very great detail and fully illustrated with very clear line drawings. *R. Hypophyllum* L. and *R. Hypoglossum* L., *Semele androgyna* (L.) Kunth, and *Danaë racemosa* (L.) Mœnch are similarly described, but with less detail. In concluding this long paper the author states that it is almost impossible to recognize what plant organ has given rise to the cladodes of *Ruscus*, *Danaë*, and *Semele*, but he considers it probable that they may be regarded as leaves whose axillary buds have disappeared. The leaves come to occupy the positions which should have been taken by the axillary branch. The inflorescence is to be regarded as an adventitious growth which appears on one or both surfaces of the cladode. There are stated to be many objections to other theories concerning the morphological nature of the cladode if the anatomical facts are taken sufficiently into account. The arrangement of the bundles is such that it is impossible to regard the cladode as a flattened stem which has assumed the appearance of a leaf. From the standpoint of phylogeny the genus *Danaë* appears to be the simplest type, since its inflorescence is normal and the young plants bear normal leaves mixed with rudimentary ones. *Semele*, which has normal leaves when young but adventitious inflorescences, is thought to represent a type intermediate between *Danaë* and *Ruscus*. The morphological nature of the cladodes of the *Rusceæ* differs from that of the cladodes of unrelated plants such as *Asparagus* spp. C. R. M.

Comparative Anatomy of the Piperaceæ.—D. ROUSSEAU ("Contribution à l'anatomie comparée des Piperacées," *Archiv. de l'Instit. Bot. de l'Université de*

Liège, 1928, **7**, 1–45, 12 pls.). An account of an anatomical investigation carried out in order to determine more precisely than has been possible from external morphological features which genera should be included within the Piperaceæ, and the systematic position of that family. The work was based mainly on a study of those portions of the leaf traces which are situated within the stem. (The nature of these anatomical units is thought to be more valuable in solving problems in systematic botany than are the characters of the individual bundles.) Six species of *Piper*, two of *Artanthe*, seven of *Peperomia*, and one each of *Saururus* and *Chloranthus* were studied, plants of different ages being examined. The more important anatomical differences between the genera studied are well summarized towards the end of the paper. The author concludes that *Piper*, *Peperomia*, *Saururus*, and *Chloranthus* constitute four groups to which he was unable to decide definitely whether to assign the rank of tribes or genera, but he is definitely of opinion that they constitute a single family. The anatomy of *Saururus* and *Chloranthus*, which on morphological grounds have by some botanists been excluded from the Piperaceæ, was found to be more similar to that of *Piper* than is the anatomy of *Peperomia*. *Piper* is stated to have a fundamental type of anatomy from which that of the other genera has been evolved. There is thought to be a causal relationship between the morphology of a given species and the nature of its bundles. Thus the stems of *Peperomia*, being relatively short and not much branched, are provided with numerous bundles having but little secondary wood. In *Chloranthus*, on the other hand, where the branches may reach a length of several metres, there is a considerable amount of secondary wood in all the bundles. If one agrees with the suggestion of Gravis that the Monocotyledons have been evolved from the Dicotyledons by the precocious reduction or extinction of the cambium, it follows that the Piperaceæ may be regarded as a family of plants intermediate in character between the two main classes of Angiosperms.

<div align="right">C. R. M.</div>

Satellites which accompany the Fibro-vascular Bundles in the Petioles of Hæmanthus Lindeni N. E. Brown.—H. Lonay ("Les satellites libèro-ligneux," *Archiv. de l'Instit. Bot. de l'Université de Liége*, 1928, **7**, 1–33, 7 figs.). Certain portions of the petioles of *Hæmanthus Lindeni* N. E. Brown are hyper-trophied. The hypertrophied tissue is the parenchyma of the mesophyll, which is firmer in consistency and more opaque than in those parts which are not hyper-trophied. In normal portions of the petiole there are about twenty vascular bundles consisting of xylem and phloem in the usual way. However, in the hyper-trophied portions, the xylem and phloem are arranged in the form of a plate lying in the antero-posterior plane, thus appearing as if they had been flattened by the pressure exerted on them by the hypertrophied tissue. These flattened bundles are accompanied by satellites, a term applied by the author to small masses, usually consisting of xylem, phloem, and digestive cells, but in some instances of phloem only. Each bundle accompanied by its satellites is stated to have the appearance of a small stele. The number of satellites attendant on a single bundle varies from one to nine in different instances. The author believes the satellites to be structures independent of the main bundles, because they arise separately in the pericycle and are connected with them only feebly and at rare intervals. The individual satellites are connected together infrequently and irregularly. They are thought to represent a curious adaptation of the conducting system to tuberization.

<div align="right">C. R. M.</div>

Anatomy and Phylogeny of Aquatic Monocotyledons.—A. Monoyer ("Contribution à l'anatomie et à l'ethologie des Monocotylées aquatiques," *Archiv.*

de l'Instit. Bot. de l'Université de Liège, 1928, **7**, 1–130, 31 pls.). It is impossible adequately to summarize this paper in a short space. Briefly, it is a full anatomical account of four groups of Monocotyledons selected on account of their different types of aquatic habitat. The four types selected are : (1) Amphibious mono-cotyledons represented by *Scirpus lacustris*. (2) Freshwater aquatics represented by a number of species of *Potamogeton*. (3) Monocotyledons which inhabit salt water, such as *Zannichellia palustris* and *Ruppia maritima*. (4) Monocotyledons which are truly marine, the selected genera being *Zostera, Cymodocea,* and *Posi-donia*. In the anatomical work attention was directed especially to the course of the leaf-traces within the stem. The bundles which collectively enter the stem from a single leaf constitute the "foliar-trace," and the number, constitution, and arrangement of these traces determine the anatomical type to which the plant belongs. The paper ends with theoretical considerations of the phylogeny of the species studied.   C. R. M.

Comparative Morphology of Scirpus sylvaticus L. and S. lacustris L.—

A. MONOYER ("Morphologie comparée du *Scirpus sylvaticus* L. et du *Scirpus lacustris* L. ; son importance au point de vue Lamarkien," *Archiv. de l'Instit. Bot. de l'Université de Liège,* 1930, **8**, 171–6, 3 pls.). A comparison of the external morphology of *Scirpus sylvaticus* L. with that of *S. lacustris* L. shows that whereas the former species has a well-developed upright stem provided with leaves, a slender scape, and a well-developed inflorescence, in *S. lacustris,* on the other hand, the length of the upright portion of the stem, as well as the number and size of the leaves, are much reduced. As a compensation for this reduction in *S. lacustris,* the scape is more fully developed, and being provided with stomata is the chief photosynthetic organ. The reduced inflorescence is often sterile. The vascular bundles are also reduced in the scape of *S. lacustris,* as only a few of them extend throughout its length. The remainder end blindly at various points, so that serial sections show progressively fewer bundles the nearer they are to the inflorescence. The author believes that these blindly ending bundles have been reduced from normal ones in association with the reduction of leaves, bracts, and inflorescence, but that they have not disappeared completely owing to the scape having become the principal photosynthetic organ.   C. R. M.

Embryo and Seedling of Ægiceras majus Gærtn.—

G. CAREY and L. FRASER ("The Embryology and Seedling Development of *Ægiceras majus* Gærtn.," *Proc. Linn. Soc. N.S. Wales,* 1932, **57**, 341–360, 32 figs.). *Ægiceras majus* Gærtn. is a mangrove occurring along the coastal rivers in the Sidney district and is viviparous. The ovule has a massive integument to which no vascular tissue passes across the funicle. The excentrically placed embryo-sac is elongated and after fertilization enlarges, absorbing the nucellus, and grows down into the micropyle. New integumental tissue is absorbed by the embryo-sac as soon as formed, while the endosperm nucleus commences to divide. Folds in the integument are produced by rapid meristematic action, and are straightened out when the peripheral endosperm tissue itself becomes meristematic. Haustorial folds of endosperm tissue grow downwards into a widened funicle. Rapid growth of the embryo keeps pace with increased growth in the endosperm and integument. Finally, the radicle and lower part of the hypocotyl emerge into the cavity of the ovary. The fruit is then shed, the hypocotyl elongates, and the radicle emerges through the ovary wall. Certain abnormal appendages occupying the position of ovules on the placenta occasionally occur.   F. B.

Foliar Endodermis in the Plantaginaceæ.—G. TRAPP ("A Study of the Foliar Endodermis in the Plantaginaceæ," *Trans. Roy. Soc. Edinb.*, 1933, 57, 523–546, 2 figs.). An endodermis was found to exist in the leaves of *Littorella lacustris* L., *Plantago alpina* L., *P. arborescens* Poir., *P. argentea* Chaix, *P. Coronopus* L., *P. lanceolata* L., *P. major* L., *P. maritima* L., and *P. Raoulii* Dcne. More thorough investigations were carried out on *Plantago arborescens* and *P. Raoulii*. All grades of distribution of the endodermis were found in the several species, from cases in which all bundles possessed an endodermis to those in which the endodermis was found only in association with the midrib and primary nerves, frequently being incomplete. Primary and secondary types of endodermal cell were recognized, the former characterized by the Caspary strip, which in the latter is followed by the internal formation of a suberin lamella. No essential difference exists between the foliar endodermis of *Plantago* and that of the typical angiospermous root. The effect of the Caspary strip on the diffusion of solutes was investigated. Acid and basic dyes and iron salts were used in 1 per cent. aqueous solutions, and very definite results were obtainable, and in a shorter period than hitherto considered possible. Outward diffusion was arrested in those areas where an endodermis was present, with a corresponding lack of control where the endodermis was absent or incomplete. Considerations submitted favour the view that the band of Caspary is impermeable to water and such substances as can penetrate the protoplasm. Though the shoot endodermis, it is suggested, is potentially functional, it appears improbable that, normally, it can prevent the leakage of sap. It is concluded, therefore, that the possession of a foliar endodermis is neither beneficial nor prejudicial. Its frequent appearance in aquatic angiosperms supports the view that it is one of the factors responsible for the promotion of the translocatory current which compensates for the lack of normal transpiration. The endodermis may be regarded as a primitive structure whose disappearance has resulted from functional deprivation. F. B.

CRYPTOGAMIA.

Pteridophyta.

Arthrostigma and Psilophyton.—W. H. LANG ("Contributions to the Study of the Old Red Sandstone Flora of Scotland. VIII. On *Arthrostigma*, *Psilophyton*, and some associated Plant-remains from the Strathmore Beds of the Caledonian Lower Old Red Sandstone," *Trans. Roy. Soc. Edinburgh*, 1933, 57, 491–521, 4 pls., 1 text-fig.). A résumé is given of former work on plant-remains in this stratum. The structure of stems of *Arthrostigma gracile* is described. Spiny stems of *Psilophyton* also are described, attention being called to the peculiar structural features of the spines; they are referred to *P. princeps* in a wide sense. Isolated smooth stems and isolated sporangia are found to resemble those of the same species. And other fossil remains are discussed. A. G.

Kidston Fossil Slides.—MARY G. CALDER ("Notes on the Kidston Collection of Fossil Plant Slides. No. 1. The Anatomy of the Axis of *Lepidodendron Brownii* Unger sp., with special reference to the Relationship between this Stem and *Lepidostrobus Brownii* Unger sp.," *Trans. Roy. Soc. Edinburgh*, 1933, 57, 547–55, 3 pls., 1 fig.). The Kidston collection of fossil plant slides is in the botanical department of Glasgow University. A careful examination of the slides of the stem of *Lepidodendron Brownii* shows that the structure is so closely comparable with that of the axis of the cone, *Lepidostrobus Brownii*, that the two may be

regarded as conspecific. The nature of the tracheids is discussed. The phloem is described and is shown to agree more nearly with that of living pteridophytes than does the phloem in other species of *Lepidodendron*.   A. G.

Xylem of Fossil Ferns.—H. DUERDEN (" On the Xylem Elements of Certain Fossil Pteridophyta," *Ann. Bot.*, 1933, **47**, 187–95, 1 pl.). Investigation of the xylem elements of *Stigmaria ficoides* and *Lepidodendron vasculare* shows that the pit areas are occupied by a double mesh of fine, closely placed vertical threads ; these are threads of thickening and do not belong to the primary wall. The xylem in the petioles of *Metaclepsydropsis duplex* and *Diplolabis Rœmeri* has a tracheidal nature, the closing membrane being present on both the side and the end walls of the elements. In petiolar xylem of *Stauropteris burntislandica* the pit-closing membrane is absent from the pits on all the walls, the xylem elements communicate openly with one another and are therefore vessels.   A. G.

Marsilia.—J. T. CUNNINGHAM and D. M. REID (" The Dehiscence of the Sporocarp and Germination of the Spores in *Marsilia polycarpa* Hooker & Greville," *J. Bot.*, 1933, **71**, 64–8, 2 figs.). An account of the dehiscence of the sporocarp of *Marsilia polycarpa* as observed in the island of Marajó, at the mouth of the Amazons, in January, 1931 ; and of the germination of the macrospores, and development of the young embryo.   A. G.

Key to Equisetum.—JOHN H. SCHAFFNER (" Diagnostic Key to the Species of *Equisetum*," *Amer. Fern J.*, 1932, **22**, 69–75, 122–8.). A key to the twenty-three recognized species of *Equisetum* arranged to facilitate the determination of plants whether sterile or bearing cones. Short descriptions are given which emphasize the distinctive characters of the species.   A. G.

Gametophyte of Adiantum.—PRAN NATH MEHRA (" Some Peculiarities in the Gametophyte of *Adiantum capillus-veneris* L.," *Current Science*, Bangalore, 1932, **1**, 169–170). Cultivation of the gametophyte of *Adiantum capillus-veneris* shows that the growing mass assumes a spatulate shape, and then by the development of an anterior lateral lobe becomes heart-shaped ; it grows thicker with age. There are no collenchymatous thickenings on the cell walls of the wings, and the author doubts whether the presence of collenchyma has any real value as a phylogenetic character ; it is probably an adaptation to ecological conditions. The gametophyte is monœcious with the sex organs usually beneath. The structure both of the antheridium and of the archegonium is of the usual Leptosporangiate type, but some of the antheridia are of a more primitive character.   A. G.

Fern Prothalli.—PRAN NATH MEHRA (" Some Physiological Investigations of Fern Prothalli under Cultural Conditions," *Current Science*, Bangalore, 1932, **1**, 171–2). Prothalli of *Anisogonium esculentum*, *Pteris longifolia*, *Goniopteris prolifera*, and *Nephrcdium molle* have been cultivated for several months under various physiological conditions. Prothalli submerged for a month put out filamentous outgrowths from the surface and marginal cells. The filaments are septate, branched, and grow towards the light ; their cells vary in length. The factors causing the production of filaments could possibly be (1) submergence ; (2) abundance of free moisture ; (3) feeble light. Experiments soon showed that submergence is not an influencing factor ; but that abundant moisture and feeble illumination are the causing factors. Experiments were then made with prothalli of *Adiantum lunulatum*, an apogamous fern which usually develops tracheids in the general body of the prothallus. When submerged and placed in feeble light, the tracheid formation was arrested and the prothalli lost their cordate form and

grew out as narrow unilamellate ribbons like the prothalli of *Hymenophyllum*, and later these become filamentous and may resemble the prothalli described for *Trichomanes*. The suggestion is made that the Hymenophyllaceæ may originally have had cordate prothalli, but that these have gradually become modified by adaptation to a life in a very damp weakly illuminated environment.   A. G.

Ceropteris.—P. N. MEHRA ("*Ceropteris calomelanos* L. in Sikkim," *J. Indian Bot. Soc.*, 1932, **11**, 340–1, 1 pl.). *Ceropteris calomelanos* is a tropical American fern which has spread to West Africa and elsewhere. It is now reported to be widely distributed in Sikkim, but is not recorded in any of the Indian floras. No doubt it is an escape from garden cultivation. Figures and a description of the plant are given.   A. G.

J. E. Smith's Ferns.—A. H. G. ALSTON ("Certain Ferns in Sir James Smith's Herbarium," *Philippine J. Sci.*, 1933, **50**, 175–83, 1 pl.). An investigation of *Davallia pectinata* Sm. shows that the type came from the Nicobar Islands; the Tahiti specimens are now separated as a new species and described under the name *Humata Banksii* Alston. In Rees's " Cyclopædia " were published descriptions of Smith's new species of ferns which have been overlooked and are not referred to in Christensen's " Index Filicum." These descriptions are reprinted and annotated in the light of modern pteridology.   A. G.

Brazilian Ferns.—E. B. COPELAND ("Brazilian Ferns collected by Ynes Mexia," *Univ. Calif. Pub. Bot.*, 1932, **17**, no. 2, 23–50, 8 pls.). Mrs. Ynes Mexia collected for a year in the province of Minas Geraes, and among her 300 specimens obtained eight new species, although the state has been closely explored by botanists in the past. These novelties, which include four tree ferns, are described in the present paper; five new name combinations are also proposed, and critical notes are given on these and some other species.   A. G.

Bryophyta.

Japanese Mosses.—K. SAKURAI ("Beobachtungen über japanische Moosflora (III)," *Bot. Mag. Tokyo*, 1932, **46**, 737–50). A list of fifty-nine Japanese mosses, including thirteen which are described as new to science, and four new varieties.
     A. G.

Thallophyta.

Algæ.

Chlamydomonad Culture. — INA LUKSCH ("Ernährungsphysiologische Untersuchungen an Chlamydomonadeen," *Beih. z. Bot. Centralbl.*, 1932, **50**, Erste Abt., Heft 1, 64–94, 3 figs.). The results of a physiological investigation of the nutrition of the Chlamydomonads, including an account of the six races employed, and descriptions of three new species. The concentration of the culture medium, the assimilation of nitrogen and of carbon compounds, and the formation of starch are then discussed. And the main conclusions drawn from the investigation are given.   A. G.

Diatoms of Gault.—ACHILLE FORTI and PAUL SCHULZ ("Erste Mitteilung über Diatomeen aus dem hannoverschen Gault," *Beih. z. Bot. Centralbl.*, 1932, **50**, Zweite Abt., Heft 1, 241–6, 1 pl., 6 figs.). The phosphorites of the Hannoverian Gault have frequently been examined for their fossil contents; but only now have the diatoms received attention. Dr. Paul Schulz devoted the last years of his

life to their study. The present paper contains descriptions and figures of nine new species and two forms.   A. G.

Navicula subsalina.—M. GARD (" A propos du *Navicula subsalina* Donkin," *Bull. Soc. Bot. France*, 1932, **79**, 581–3). An account of a form of *Navicula subsalina* which at times occurs widespread over the mud flats of the Garonne. Samples were submitted to Peragallo and received the varietal name *rivularis*; it is a fresh-water form, and is associated with *Euglena limosa*. Notes on its structure and biology are given; and the affinity with *N. amphisbœna* is discussed.   A. G.

Diatoms of the Tay.—DAVID MCCALL (" Diatoms (Recent and Fossil) of the Tay District," *J. Linn. Soc. Bot.*, 1933, **49**, 219–308, map and 38 figs.). An attempt to give a complete list of the diatoms of the district of the Tay Estuary, an area of 27 by 16 miles, comprising sea-coast, sandy shore, meadowlands, uplands, and a large river, and yielding marine, brackish, lowland fresh water, subalpine, and alpine species. In all, 920 species and varieties are represented, a few of which are new records for Britain; also nine new species, twenty-three new varieties, and some forms are described. The material was collected from eighty-one localities. Auxospore formation was found in twenty-one species; in *Diatoma hiemale* it was previously unknown. The occurrence of *Navicula gibbula* and *N. Semen* on the Sidlaw Hills is noteworthy as a survival of Arctic forms from the Glacial period.   A. G.

Phytoplankton of Saint-Malo.—CH. BATARD (" Phytoplancton estival des cours d'eau de la région de Saint-Malo," *Bull. Soc. Bot. France*, 1932, **79**, 603–12, 1 fig.). A study of the phytoplankton of the Rance and other rivers in the neigh-bourhood of Saint-Malo in August and September, 1927, yielded a list of forty-three diatoms, six flagellates, four Protococcaceæ, three Confervaceæ, and seven other algæ. The species characterizing each of the rivers are discussed; one group of five rivers has a plankton poor in diatoms, while the remaining two rivers are rich in green algæ and in diatoms. The ecological factors are discussed.
                                                                        A. G.

Salt Marsh Algæ.—NELLIE CARTER (" A Comparative Study of the Alga Flora of Two Salt Marshes. Part II," *J. Ecology*, 1933, **21**, 128–208, 26 figs.). The first part of this paper (*op. cit.*, 1932, **20**, 341–70) gave the topography of the two salt marshes under investigation, respectively at the estuary of the Dovey in Wales, and on Canvey Island in Essex. The present part comprises a systematic list of the algæ observed, with figures of the characteristic features of many of the species, and critical notes.   A. G.

Ecballocystopsis.—M. O. P. IYENGAR (" *Ecballocystopsis indica* n.gen. et sp., a New Member of Chlorodendrales," *Ann. Bot.*, 1933, **47**, 21–5, 1 pl.). Description of a new genus of green algæ from the Honey Falls at Courtallum in S. India. Though very closely related to *Ecballocystis*, with which it grows, *Ecballocystopsis* differs in having a filamentous habit, as contrasted with the dendroid habit of *Ecballocystis*. This difference of habit is the result of the different method of division and behaviour of the daughter-cells.   A. G.

Fritschiella.—M. O. P. IYENGAR (" *Fritschiella*, a new Terrestrial Member of the Chætophoraceæ," *New Phyt.*, 1932, **31**, 329–35, 1 pl., 2 figs.). A description of *Fritschiella tuberosa*, a new alga found in pools when drying up after the north-east monsoon. This new genus belongs to the Chætophoraceæ and is allied to *Iwanoffia* and *Stigeoclonium*; it is attached by rhizoids and consists of a prostrate

system of clusters of small thin-walled cells with dense contents probably serving for purposes of perennation, and of a projecting system composed of branched filaments with cells short below and elongate above; no setæ are present; spore reproduction is still unknown. A. G.

Gongrosira and Spongilla.—PEDRO GONZÁLEZ GUERRERO ("La asociación *Gongrosira-Spongilla* en el río Zújar (Badajoz)," *Bol. Soc. Española Hist. Nat.*, 1932, **32**, 449–51, 6 figs.). An account of *Gongrosira pygmœa*, a green alga of the Trentepohliaceæ which grows on submerged rocks in the river Zújar (Badajoz) abundantly and closely associated with the freshwater sponge *Spongilla*. The *Gongrosira* is a new record for the Spanish flora; and its morphology and mode of growth are described. A. G.

Algæ of River Beds.—R. W. BUTCHER ("Notes on New and Little-known Algæ from the Beds of Rivers," *New Phyt.*, 1932, **31**, 289–309, 1 pl., 7 figs.). An account of the algæ obtained on glass slides submerged for a month in the Tees, Lark, Itchen, and other rivers. Descriptions and figures of *Sporotetras pyriformis* and *Sphœrobotrys fluviatilis* (in both cases the genus and species are new), and of *Ulvella frequens* (a new species) are given; also of new forms of *Stigeoclonium falklandicum* Kütz. and *St. farctum* Berthold. The morphology of *Gongrosira incrustans* Schmidle and of *Chœtopeltis megalocystis* Schmidle is described and figured. The glass slide method of growth permits the prostrate growth stages of the plants to be studied; such stages are found to vary with the time of year, the rapidity of the current, etc. Other little-known algæ are included in the list. A. G.

Swedish Algæ.—GÖSTA R. CEDERGREN ("Die Algenflora der Provinz Härjedalen," *Arkiv. för Botanik*, 1933, **25**, A, no. 4, 1–109, 4 pls., 25 figs.). A systematic account of the freshwater algæ of the province Härjedalen in south Norrland, which the author has been studying since 1913. The results are 3 Flagellatæ, 51 Myxophyceæ, 99 Chlorophyceæ, 319 Conjugatæ, 4 Charophyta, and 6 Florideæ. Among them are 17 species and several varieties new to Sweden; and 2 species and 7 varieties are new to science. A. G.

Indian Myxophyceæ.—YAJNAVALKYA BHARADWAJA ("Contributions to our Knowledge of the Myxophyceæ of India," *Ann. Bot.*, 1933, **47**, 117–43, 8 figs.). An account of the following blue-green algæ: *Cylindrospermum muscicola* Kütz. var. *kashmirense*, a new variety from Srinagar, with heterocysts at both ends of the filaments. *Aulosira Fritschii*, a new species from Benares; the formation and germination of the spores are described. *A. prolifica*, a new species from Benares, exhibiting only vegetative reproduction. *A. pseudoramosa*, also from Benares, a new species characterized by a false branching due to the germination of hormogones *in situ*. A. G.

Bifurcaria.—ETHEL M. REES ("Some Observations on *Bifurcaria tuberculata* Stackh., *Ann. Bot.*, 1933, **47**, 101–15, 7 figs.). An account of the distribution, habitat, and method of growth of *Bifurcaria tuberculata*, special attention being called to the rhizome, an unusual feature in the Fucaceæ. The anatomy of the plant is described; stages in the development of the hermaphrodite conceptacle are figured. The oogonia are at the base of the conceptacle, and each produces a single egg, a survival of one out of eight. The affinity of the genus is with *Cystoseira*, *Halidrys*, and *Sargassum*. A. G.

Spanish Algæ.—F. MIRANDA ("Adiciones y correciones a la lista de algas marinas de Gijón," *Bol. Soc. Española Hist. Nat.*, 1932, **32**, 435–8). A supplement to the author's list of marine algæ of Gijón (*Trab. Mus. Nac. Cienc. Nat.*, 1931, no. 25, 1–106) which comprised 35 Cyanophyceæ, 2 Conjugatæ, 41 Chlorophyceæ, 69 Phæophyceæ, and 166 Rhodophyceæ. The present list contains a score of species most of which are additions. Gijón is situated on the north coast of Spain.   A. G.

Japanese Algæ.—YUKIO YAMADA ("Notes on some Japanese Algæ, IV," *J. Fac. Sci. Hokkaido Imp. Univ.*, 1932, Ser. V, Bot., **2**, no. 2, 267–76, 7 pls., 3 figs.). The following new species are described: *Avrainvillea riukiuensis, Leathesia sphærocephala, Callithamnion callophyllidicola, Callophyllis adhærens, Laurencia hamata.* Notes on other species are given.   A. G.

Algal Metabolism.—P. HAAS and T. G. HILL ("Observations on the Metabolism of Certain Seaweeds," *Ann. Bot.*, 1933, **47**, 55–67). A discussion of the fats, sugars, and nitrogen compounds of some marine algæ, and a statement of certain facts relating to the metabolism of these plants. These facts concern: (*a*) The direct increase of fatty substances proportional to the emergence from the sea and the exposure to the air ; the increase in unsaponifiable residue in proportion to the depth of immersion ; and the increase in the saturation of the ether-extract proportional to the degree of emergence. (*b*) The absence or paucity of free sugars ; the probably constant occurrence of mannitol in the Phæophyceæ ; the absence of mannitol, and presence of dulcitol and sorbitol in *Bostrychia.* (*c*) Nitrogen metabolism, especially the occurrence of an octapeptide of glutamic acid in the Phæophyceæ of the higher littoral zones, and a pentapeptide in *Corallina, Lithothamnion,* and *Griffithsia.*   A. G.

<center>Fungi.</center>

Study of Synchytrium.—WALTHER RYTZ ("Beiträge zur Kenntnis der Gattung *Synchytrium* III," *Ber. Deutsch. Bot. Ges.*, 1932, **50**, 463–71). The author has attacked the problem of specificity from the infection point of view. The species of parasite experimented with was of the *Synchytrium aureum* type and formed galls on *Brunella vulgaris.* He tested its power of infection on a large series of plants belonging to different genera. By means of these he was able to prove various points : that the *Synchytrium* on *Brunella vulgaris* is not identical with that on *Lysimachia nummularia ;* he recognized a real immunity in these and other plants. He succeeded, however, in infecting *Gleichoma hederaceum,* but he considers that it may act only as an opportune and temporary carrier of the parasite.   A. L. S.

Spore Germination.—WILLY HÖHNK ("Polyplanetism and Zoospore Germination in Saprolegniaceæ and *Pythium*," *Amer. J. Bot.*, 1933, **20**, 45–62, 1 pl., 6 text-figs.). Höhnk has attacked the problem of planetism in spores and has given his results and views as to its value in systematy. He has made cultures of many species in dry and in moist conditions, and gives many interesting results ; much, he found, depended on the presence or absence of water. The spore cilia indicating planetism are described, as well as the resting stage and the further formation of cilia or diplanetism ; there might also occur a third, or more, swarm periods (*Achlya racemosa*). In his summing up he states : "Planetism is a poly-planetism of which the diplanetism is a certain phase." There are varying types

of planetism as well as the varying types of spore discharge, which can be explained by means of adaptation to environmental conditions. The many stages are well illustrated. A. L. S.

Formation of Fruit-bodies in Fungi.—C. Moruzi ("Recherches cytologiques et experimentales sur la Formation des Perithèces chez les Ascomycètes," *Rev. Gén. Bot.*, 1932, **44**, 268–302, 11 pls.). This paper is more or less the summing up of previous work. The author concentrates on the genus *Neurospora*. She finds the following stages : (1) An ascogonium multinucleate, then septate, giving place to an ascogenous formation of uninucleate cells and the formation of croziers rising directly from the uninucleate ascogenous hyphæ ; there is no fecundation at the origin of the perithecia. She finds sclerotia which are arrested perithecia in cultures of *Neurospora*. Also + and − mycelia in *Neurospora* which are not of different sexes, as each can form ascogonia, and may produce sclerotia and perithecia. Either, she concludes, there is a sexuality differing from the ordinary idea or there is no sexuality. In heterothallic *Neurosporæ* the hyphæ + and − do not fuse at the origin of the perithecia, but influence each other up to the formation of sclerotia or even to the formation of perithecia. The reaction between mycelia is not "specific." The mycelium of different species may exert this influence to the development of sclerotia or even perithecia. A long list of the literature bearing on the subject is cited. A. L. S.

British Species of Diaporthe.—L. E. Wehmeyer ("The British Species of the Genus *Diaporthe* Nits. and its Segregates," *Trans. Brit. Mycol. Soc.*, 1933, **17**, 237–95). The genus as described includes species with equal two-celled ascospores and with a conidial stage of the *Phomopsis* type. The associated genera—the segregates—are *Apioporthe* with unequal two-celled ascospores, and those with one-celled ascospores, *Diaporthopsis*. These all form black limiting lines as a zone within the substratum. Still another associated genus with two-celled ascospores, *Cryptodiaporthe*, does not form a black zone. The author has described the types of stroma—effuse, pustulate-effuse, or isolate—associated with each species. Some species are confined to one host, others occur on different hosts. The key to the species has been drawn up without reference to hosts, the form of the stroma being used as a leading characteristic, as well as the general type of hosts, as herbaceous or woody. The species with the largest range of hosts is *Diaporthe eres* Nits., recorded on nearly twenty different hosts, both herbaceous and woody. The descriptions of genera and species are very full ; perithecia with pycnidia and their spores and other microscopic characters are described in great detail. Synonyms are numerous, all being quoted. Account is also taken of species wrongly classified under *Diaporthe*. A. L. S.

Development of Neurospora.—Carl C. Lindegren ("The Genetics of *Neurospora*—III," *Bull. Torr. Bot. Club*, 1933, **60**, 133–54, 1 pl., 6 text-figs.). Lindegren started his cultures with eight mycelia grown from the eight ascospores of a single ascus. These were developed and further cultures of each generation were made. All these breeding experiments are described and the results set out in tables. From these he secured six pure bred stable stocks. Finally, he sums up that "the evidence indicates that (1) the ascus nucleus of *Neurospora crassa* is diploid ; (2) that the reduction of the diploid nucleus to four haploid nuclei is effected in the first two divisions of the ascus nucleus ; (3) that crossing-over occurs at the four-strand stage ; (4) that the spindle-fibre attachment is segregated reductionally at the first meiotic division." A. L. S.

Sordaria Spores.—WINIFRED M. PAGE (" A Contribution to the Life-History of *Sordaria fimicola* (four-spored form) with Special Reference to the Abnormal Spores," *Trans. Brit. Mycol. Soc.*, 1933, **17**, 296–301, 5 text-figs.). A four-spored form of *Sordaria fimicola* appeared on a soil culture of Discomycetes. The methods of culture are described. The ejected spores taken from the original culture were : (a) dwarf spores with two nuclei which gave rise to mycelia of two kinds, A and B; (b) normal spores with four nuclei which gave rise to homothallic mycelia ; (c) giant spores with eight nuclei which also gave rise to homothallic mycelia. Germination of the spores with description of the mycelia, and the fusion between mycelia follows, with the further development of the fruiting body. The young ascus contains at first one large nucleus, at a later stage eight nuclei, and later still sixteen, but the number and size of the resulting spores vary very considerably. In every perithecium examined, several asci contained five spores, three of normal size and two dwarfs. Other variations in number and size are recorded, as also the results of culture of these various spores, and the fruiting bodies that resulted from fusion of the different mycelia.   A. L. S.

Study of Mytilidion.—MARION LOHMAN (" *Septonema toruloideum*, a Stage of *Mytilidion scolecosporum*," *Mycologia*, 1933, **25**, 34–35, 1 pl.). The occurrence of the Hyphomycete *Septonema* in the vicinity of *Mytilidion*, a genus of Hystereaceæ, suggested a close association of the two fungi. Ascospores of *Mytilidion* were grown in cultures and the conidial form, bearing chains of septate conidia, were produced, the gradual transformation into chains was followed. In each mature septate conidium the basal cell is the oldest and each succeeding cell to the distal end of the conidium has followed in order ; these yellow to brownish cells measured 2–3µ in diameter.   A. L. S.

Epidemiology of Rusts.—HARRY G. UKKELBERG (" The Rate of Fall of Spores in Relation to the Epidemiology of Black Stem Rust," *Bull. Torr. Bot. Club*, 1933, **60**, 211–28, 4 text-figs.). Ukkelberg submits his study as an attempt to solve the problem of the occurrence of epidemics of stem-rust in the spring-wheat area. The various writers on the subject have suggested as explanations, the dissemination of urediniospores that survive the winter from north and south, or æciospores from barberry bushes. Other suggestions are that of long-distance dissemination by spores borne at very high altitudes. The paper deals mainly with the rate at which the different spores fall when mature ; it was found that there was a difference in the rate in four cereal rusts which was statistically significant ; that the velocity of fall of æciospores of *Puccinia graminis-tritici* and *P. graminis-secalis* was less than that of the urediniospores of these rusts. This fact has considerable effect on dissemination. Finally he concludes : " The average theoretical dispersal distance of æciospores, based on their rate of fall, is greater than that of urediniospores."   A. L. S.

Spore Dissemination.—W. TSCHASTUCHIN (" Die biologische Bedeutung der Fruchtkörper der Hutpilze," *J. Bot. de L'U.R.S.S.*, 1932, **17**, 183–4). The author has seen reason to question the completeness of the views on spore dissemination in Agarics. Air currents have been deemed the main factors, but Tschastuchin draws attention to the early dissolution of the fungus before a tithe of the spores have been disseminated. He has experimented with flies of various kinds, worms, snails, etc., and has found in each case that these creatures devour the rotting fungi and their spores and that these spores pass through them unharmed, thus providing a very wide and varied dissemination.   A. L. S.

Dry-Rot Spores.—W. P. K. FINDLAY ("The Germination of the Spores of *Merulius lacrymans* (Wulf) Fr.," *Trans. Brit. Mycol. Soc.*, 1933, **17**, 334–35, 1 text-fig.). The difficulty in inducing the germination of *Merulius* spores in artificial cultures has long been known. Continental workers had found that the addition of acid to the culture medium brought about germination, and this method was adopted by Findlay, who used 8 p.c. malt agar plus 1 p.c. malic or phosphoric acid. Approximately a quarter of the spores tested had germinated. Sterilized wood treated with acid was infected with spores; no germination followed, but a few spores germinated on untreated Sitka spruce and beech. A. L. S.

Russula Spores.—GEORGES MALENÇON ("Considérations sur les spores des Russules et des Lactaires," *Bull. Soc. Mycol. Fr.*, 1931, **47**, 72–86, 1 pl.). Malençon describes the origin and appearance of the dots and markings on the surface of *Russula* and *Lactarius* spores. He describes the spore itself, which changes in form from globose to piriform in the course of development, thus stretching unequally the outer membrane and so giving rise to inequalities, and affecting also the form and position of the outer dots or warts which otherwise would be a fixed series. A. L. S.

Constitution of Fungus Cell-membrane.—RAYMOND NARDI ("Sur la Constitution de la Membrane Cellulaire des Champignons," *Bull. Soc. Mycol. Fr.*, 1931, **47**, 113–17). The writer sets forth the various results of the chemical examination of fungal tissue. The fundamental substance of the cell wall has been declared as either callose (sometimes called fungose) or chitine; the former without, the latter with nitrogenous content. The author decides, however, that probably both of these substances are present in the cell membranes. A. L. S.

Sexuality in Hymenomycetes.—R. VANDENDRIES ("Les Polarités sexuelles de *Coprinus tergiversans* Fr.," *Bull. Soc. Mycol. Fr.*, 1931, **47**, 36–43). The author gives his explanation of the presence or absence of sexuality in the spores of this fungus: there are clamps in the mycelium giving rise to conjugate nuclei which convey bisexuality or a sexual relativity; though not all of those that unite in the basidium give rise to sexual spores. This depends on the nature of the nuclei, which may be of the same or opposite sex before fusion. A. L. S.

Wood Decay.—RALPH M. LINDGREN ("Decay of Wood and Growth of some Hymenomycetes as affected by Temperature," *Phytopathology*, 1933, **23**, 72–81). The final object of the research was to combat the destruction of timber by fungi. It was carried out by cultures of different fungi on wood, calculating the deterioration caused at different temperatures. A result of the experiment showed that wood decay went on most rapidly at the temperatures most favourable to fungus growth. There was considerable difference in susceptibility to decay, due not only to the type of fungus but to the kind of wood. High temperatures were the most favourable to decay, but the agar cultures did not entirely reflect natural conditions. A. L. S.

Zone Lines in Plant Tissues.—ALEX H. CAMPBELL (*Ann. App. Biol.*, 1933, **20**, 123–45, 3 pls.). The writer gives a sketch of the black lines formed by different woods and also of the work and theories of timber students as to their origin and constitution. He selects out of many *Xylaria polymorpha*, a common pyrenomycete on decaying stumps of deciduous trees, and examines by cultures, etc., the formation and structure of the black zones. The first experiments were a culture of the spores and another of the black line tissue; the resulting growth was the

same. A description of the cultures follows, and then a more detailed account of
the appearance of the lines, with a description of the fungus stroma. He has
compared this very evident stroma with the reduced stromata of other fungi, and
he has concluded that the internal black lines are the "marginal zones of ento-
stromata in the substratum comparable to those occurring in *Diaporthe*" and
other stromatoid fungi. Campbell has also examined the nature of the zone line
where dissimilar fungi meet in the host tissue as, for instance, *Fomes applanatus*,
in which the zone line is formed of wound gum by the parasitic species, which begins
as a heart-rot and works towards the periphery.   A. L. S.

Russula pseudo-violacea Joach. n.sp.—L. JOACHIM (*Bull. Soc. Mycol.
Fr.*, 1931, **47**, 256–7, 1 pl., 1 text-fig.). This species, allied to *R. violacea*, is dis-
tinguished by the persistent violet colour on the edge of the cap and the large
spores. A description of the new species with microscopic details of cystidia and
spores is given. It occurred several years in succession in forests near Paris.
                                                                                   A. L. S.

Study of Podaxis.—ELIZABETH EATON MORSE ("A Study of the Genus
Podaxis," *Mycologia*, 1933, **25**, 1–33, 12 pls.). The author has made a prolonged
search for specimens, and she presents her carefully thought out views concerning
the fungus. Search was successfully made in the Colorado desert and specimens
were received from other places—California, India, South Africa, etc. The sporo-
phores originate from mycelium which ramifies in warm, moist, sandy soil. In
time the plant breaks through the soil and rapidly grows from 1 to 2 inches daily.
The plants may grow singly or matted together by interlacing mycelium in the
soil. Many descriptions of *Podaxis* have been given under many names, but the
present writer decides that there is but the one species, *Podaxis pistillaris*, a member
of the Gasteromycetes. The spores are borne on basidia; they vary greatly in
size; the capillitial threads are also variable in diameter, changing with the age of
the fungus both in size, shape, and colour. All these variations occur in the plant
at different stages, though many workers regarded them as specific characters.
The writer places the genus as a transition between Gasteromycetes (Lycoperdales)
and Hymenomycetes.   A. L. S.

Skin Parasites. — T. KAMBAYASHI ("Botanische Untersuchungen über
japonische Fadenpilze, die auf der Menschenhaut parasitieren, Mitt. II. *Micro-
sporon japonicum*," *Bot. Mag. Tokyo*, 1932, **46**, 751–71, 3 pls., 14 text-figs.). The
fungus described was discovered by the author in Tokyo (1919); since then it has
been identified from other Eastern localities. It is here fully described after
prolonged examination by culture. Special attention was paid to the varied types
of fructification: (1) Conidia budded off from the hyphæ; (2) chlamydospores
which occur as rather large swellings in or at the tips of the hyphæ; (3) spindel-
spores at the tips of the hyphæ, doubtfully regarded as chlamydospores of elongate
form; and (4) ascus-like organs which were found in a culture after 261 days:
they arise as swellings enclosing numerous globose cells, small but varying in size.
It is not decided as yet whether these are asci or not. The fungus is suggestively
placed among the Hemiasci.   A. L. S.

Study of Mycorrhiza.—A. B. HATCH and K. D. DOAK ("Mycorrhizal and
other Features of the Root Systems of *Pinus*," *J. Arnold Arb.*, 1933, **14**, 85–99,
4 pls.). The writers have devoted their attention to the various types of long
and short roots in *Pinus*. The long roots include the radicle or tap-root; the
short types are laterals termed mother roots, and continuations of these—pioneers.

They are distinguished by their bundle systems. The "short roots" are those that are infected with the mycorrhizal fungus, though not all of them, and it was found that they may continue to grow after attack by the fungus, as profuse dichotomous branching is a feature of the infected roots.   A. L. S.

Polymorphism of Spores.—R. Morquer ("Polymorphisme et Déterminisme de la Formation des Spores chez le *Dactylium macrosporum*," *Rev. Gén. Bot.*, 1932, **44**, 145–52). An experiment has been made to study the effect of modifications in the substance of the cultures on the form of the spore. The author describes the various means of changing the character of the media, physical and chemical, and has described that in the case of *Dactylium macrosporum* the variations induced have been considered sufficient to provide grounds in many cases for separation into species and even genera of the same fungus. From spores of *Dactylium* he claims to have secured growths of two other genera, *Diplocladium* and *Mucrosporium*.   A. L. S.

Study of Micromycetes.—T. Rayss ("Contribution à la Connaissance des Micromycètes aux Environs de Besse (Puy-de-Dôme)," *Bull. Soc. Mycol. Fr.*, 1931, **47**, 200–20, 3 text-figs.). Rayss has made a contribution of seventy-three micromycetes belonging to many different families and genera. The paper includes new species and new hosts. Peronosporaceæ and Pucciniaceæ are well represented. A special description is given of *Puccinia Epilobii-tetragoni*, with tables of spore-sizes, etc.   A. L. S.

Notices of British Fungi.—J. Ramsbottom ("Index to Berkeley and Broome's Notices of British Fungi," *Trans. Brit. Mycol. Soc.*, 1933, **17**, 308–30). These "notices," so helpful to mycologists in the early days of mycology, were published at first by Berkeley from 1837 to 1844, and then by Berkeley and Broome down to the year 1885, thirty-five different publications mostly in the *Ann. Mag. Nat. Hist.*, the entries in that period numbering 2050. The fungi enumerated have been listed according to the generic names given, a large number under *Agaricus* and other Basidiomycetes, but also a very long list of moulds and other microscopic genera and species.   A. L. S.

Development of Fructification in Fungi.—P. Martens ("L'origine du 'crochet' et de 'l'anse d'anastomose' chez les Champignons supérieurs," *Bull. Soc. Mycol. Fr.*, 1932, **48**, 259–81, 1 pl.). The author has outlined the history of work done on fructification in the higher fungi—Ascomycetes and Basidiomycetes. He notes in Ascomycetes the ascogenous hyphæ at the extremity of which is formed the "crozier," with division of the nuclei, the upper cell becoming binucleate, and, finally, the fusion of the two nuclei to form the ascus. Martens compares the crozier with the clamp connections in the Basidiomycetes. The literature of the subject has been examined and criticized. The conclusions arrived at by the author as to the value of the crozier refer to the end position of the upper cell with the two nuclei. The necessity for the end position of this binucleate cell is explained, and the necessity for the two nuclei to be placed side by side as they are in the crozier. Other cases are cited in which the hyphæ are wider and the crozier formation is not necessary.   A. L. S.

Micromycetes of Sweden.—Carl Hammarlund ("Beiträge zur Kenntnis der Mikromycetenflora der Provinz Skåne (Schonen)," *Ark. Bot.*, 1933, **25**, 2, 1–126, 3 pls.). Hammarlund gives a sketch of the territory in Skåne, the most southerly province of Sweden. He describes the conditions—temperature, rain-

fall, etc. Many species are parasites, the host-plants being indicated, and biological notes are frequently added with descriptions and figures of several species, two of them new to science.   A. L. S.

Determination of Conidial Form.—HELENE GROSMAN ("Ueber die Systematischen Beziehungen der Gattung *Leptographium* Lagerberg et Melin zur Gattung *Ceratostomella* Sacc.," *Hedwigia*, 1932, **72**, 183–94, 8 text-figs.). By means of cultures, the author has been able to identify the species as allied to *Ceratostomella : Leptographium penicillatum* becomes *C. penicillata* Grosman. It is characterized by the darkening colour of the mycelium, the erect, brown conidiophores of penicillate type, and by the colourless spores 11–12μ × 3–5μ. The pycnidial bodies (*Ceratostomella*) are dark-coloured with minute spores. A similar fungus—*Hantzschia Phycomyces* Awd. (*Graphium Phycomyces* Awd.)—has also been included in *Leptographium;* the higher form is not yet determined.   A. L. S.

Disease of Roses.—G. EDWARD DEACON ("Some Effects of *Botrytis cinerea* on Roses," *Trans. Brit. Mycol. Soc.*, 1933, **17**, 331–3, 1 pl.). The hurtful effects of die-back in roses was evidently caused by the mould-like fungus *Botrytis cinerea*. In order to make certain as to the cause of the trouble, experiments were made by Deacon by setting apart certain rose trees, infecting some with the fungus and using others as control plants in similar conditions. He made a small incision in the bark of the experimental plants and inserted the fungus. There was evidence in most of the inoculated plants that the *Botrytis* was the hurtful agent in die-back. Mycelium and conidia of the fungus appeared about the third week after infection. When the infected parts were cut out and the plant restored to natural conditions, it grew well and seemed little the worse for the infection.   A. L. S.

Pink Root of Onion.—I. R. PORTER and H. A. JONES ("Resistance of Some of the Cultivated Species of *Allium* to Pink Root (*Phoma terrestris*)," *Phytopathology*, 1933, **23**, 290–98, 1 text-fig.). Pink root is destructive to many species of *Allium ;* the disease has been traced to a soil-inhabiting fungus, *Phoma terrestris*. The authors of the paper describe their efforts to discover onion species that were not susceptible. This they did by growing species of *Allium* in infected soil. Those of most importance commercially were the most susceptible, but others (Leek and Chives) were resistant, and further experiments are to be undertaken by hybridizing to secure plants with more or less immunity.   A. L. S.

Verticillium Hadromycosis.—W. V. LUDBROOK ("Pathogenicity and Environal Studies on *Verticillium Hadromycosis*," *Phytopathology*, 1933, **23**, 117–154). The writer experimented with two species—*Verticillium albo-atrum* R. & B., and *V. Dahliæ* Kleb.—his object being to test the temperature and other influences on development; this he did by cultures and inoculations on various host-plants. He found that there was a different temperature optimum for these two species of vascular *Verticilliæ* : *V. albo-atrum* not causing disease above 30°, *V. Dahliæ* confined to a slightly lower figure. Variation of soil moisture had no marked influence on the development of the disease.   A. L. S.

Lupin Disease.—D. E. GREEN ("A Lupin Disease due to *Ceratophorum setosum* (Kirchner), a Fungus new to Britain," *J. Roy. Hort. Soc.*, 1933, **58**, 144–5, 1 pl., 2 text-figs.). The fungus described appeared first as a leaf spot on the basal leaves of the Lupin, spreading later to the upper foliage. It was identified as *Ceratophoron setosum* found on the Continent, but now the first record for Britain. The leaves of the plant are soon killed; infection is by means of spores, rather long 2–7-septate spores with four or more hair-like projections at the end. Further investigation is promised.   A. L. S.

Study of Corn Ear Rot.—A. H. EDDINS and R. K. VOORHEES (" *Physalospora zeicola* on Corn and its Taxonomic and Host Relationships," *Phytopathology*, 1933, **23**, 63–72, 2 text-figs.). A disease of maize in Florida was found to be caused by a species of *Physalospora*. The question of identity was taken in hand : ascospore cultures were made and typical pycnidia and spores of *Diplodia frumenti* were obtained with the evidence of relationship between these two fungi. Culture experiments on host plants proved that the *Diplodia* was the pycnidial stage of *Physalospora zeicola* Ell. & Ev. The parasites have a large range of host plants in many different families and species. A study was made of the fungi, and asci and spores were measured and compared—spores 13–27μ × 6–11μ. They vary considerably, however, on the same or different hosts.   A. L. S.

Parasite on Rust.—L. J. MIELKE (" *Tuberculina maxima* in Western North America," *Phytopathology*, 1933, **23**, 299–305). The parasite known as the lilac fungus has been known as a parasite of *Cronartium ribicola*, the white-pine blister rust. It is widely distributed in Europe, but only recently has been found in America, though there is evidence that it is indigenous there. The parasite lives on the pycnidia and æcidia of the rust, but there is no evidence that it has to any extent affected the rust disease ; it grows by preference on the pycnidia ; it has not been reported on uredosori or teleutosori.   A. L. S.

Decay of Apples.—G. A. HUBER (" *Aspergillus sclerotiorum* n.sp. and its Relation to Decay of Apples," *Phytopathology*, 1933, **23**, 306–8, 1 text-fig.). This new species belongs to the *A. ochraceus* group, the growth becoming sulphur yellow. Huber isolated the fungus from the surface of apples ; it was the only one among many other surface moulds that caused decay. The appearance and microscopic characters are described. On a carrot slice it developed numerous sclerotia. When inoculated into sound, ripe Jonathan apples it produced lesions something like flattened cones.   A. L. S.

Lichens.

Study of Nephroma.—V. GYELNIK (" *Nephroma*-Studien," *Hedwigia*, 1932, **72**, 1–30, 2 text-figs.). Gyelnik publishes here the notes he has made on species of *Nephroma* in the Hungarian National Museum for the Rabenhorst Kryptogamenflora. In the key to these species he relies on chemical characters and also on smooth or tomentose under-surfaces. The presence or absence of isidia and soredia have also proved good diagnostic characters. Many new species, varieties, and forms have been made, largely on the minute or microscopic characters of these bodies. The presence or absence of cephalodia and cyphellæ is also noted in the various species, along with the microscopic details of the apothecia.

A. L. S.

Rare Lichens from Japan.—YASUHIKO ASAHINA (*J. Jap. Bot.*, 1932, **8**, 305–7, 1 map ; English 33–4, 2 text-figs.). Records of two rare lichens. One of these, *Glossodium japonicum* A. Zahlbr. n.sp., is the second species of the genus ; *Acroscyphus sphærophoroidi* is a less rare plant found in South America and North India.   A. L. S.

Study of Lichen Gonidia.—EDUARD FREY (" Die Spezifizität der Flechtengonidien," *Ber. Schweizerisch. Gesellsch.*, 1932, **41**, 180–98). In this paper Frey has provided not only a résumé of the recent results achieved by students, but has given many suggestions as to the furtherance of knowledge on certain lines. He first summarizes the proofs obtained as to the algal independence of the gonidia

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in answer to Elfving's recent repetition of his views on their hyphal origin. He explains the difficulties encountered in the culture either of the separate organism or of the thallus itself. He points out that the alga as a gonidium has suffered a change that interferes with easy culturing, and he considers that development of the thallus would be more successful if a beginning were made by minute scraps of the thallus or by soredia. He also suggests that an attempt should be made to supply not only what might be judged to be natural foodstuffs but also the natural habitat as, for example, a stone or piece of bark washed over with a nitrogenous or other solution. He suggests that there should be a publication of all the work done on the alga—in the free as in the gonidial state. A résumé of recent literature on the subject is appended.   A. L. S.

Study of Alectoria.—V. GYELNIK (" *Alectoria* Studien," *Nyt. Mag. Natur-vidensk.*, 1932, **70**, 35–62). Gyelnik in this study has discussed only the European species and has emphasized the importance in their classification of chemical reactions and of the presence of isidia and soredia. He thus classifies them in groups according to these characters, but he also includes the natural colour as specific. Following on these lines he creates a number of new species, varieties, and forms. He has discussed the question of soredial formation; he considers that the smallest formation of soredia indicates the tendency to form these bodies, and therefore he includes the plant in the soredial section. The proposal to grow them under varying conditions is so far not practicable.   A. L. S.

Study of Dermatocarpon.—F. and F. MOREAU (" Recherches sur les lichens du Genre *Dermatocarpon*," *Rev. Gén. Bot.*, 1932, **44**, 305–15, 4 pls.). The authors have described and compared three species of *Dermatocarpon*—their outward appearance, anatomy, etc. The gonidium in one species at least does not form aplanospores ; the contents divide into four cells and represent Chodat's genus, *Coccobotrys*. They find, as did Baur (1904), coiled ascogonia of uninucleate cells with abundant protoplasm and rather large nucleus. Several ascogonia may mingle their coils, each one forming a trichogyne which degenerates, however, before reaching the surface. Sterile filaments surround the archegonia and in time form the wall of the perithecium. Some of the cells, at least, are multi-nucleate. At a further stage there is a formation of uninucleate cells—the young ascogonial hyphæ—which later form binucleate cells, a crozier, and the asci. After fusion of the nuclei, the fused nucleus undergoes three mitoses and finally eight ascospores are formed, unicellular or, in *D. cinereum*, bicellular. The same type of ascogonial development has been observed in *Lecanora*, *Placodium*, and *Squamaria* by Mlle. Moruzi. The authors trace in these developments a common ancestry for Discolichens and Pyrenolichens which does not conform entirely with the Pyrenomycetes. They, in any case, consider Pyrenomycetes as a heterogeneous group.   A. L. S.

Lichens from S. France.—H. DES ABBAYES (" Lichens des environs de Banyuls (Pyr.-Or^les.). Observations écologiques et bionomiques. Description de deux espèces nouvelles," *Rev. Bryolog. et Lichénolog.*, 1932, **10**, 10–26, 2 text-figs.). The writer has confined his attention to the larger lichens, and has devoted attention to their ecology. He notes the frequency of certain species such as *Parmelia scortea* and *P. soredians*. He describes two new species—a *Parmelia* with microscopic details, and a *Dermatocarpon* without fructification determined by Bouly de Lesdains.   A. L. S.

Lichens of Formosa.—A. ZAHLBRUCKNER (" Flechten der Insel Formosa," *Rep. Spec. Nov. Reg. Veg.*, 1933, **31**, 194–422). Zahlbruckner gives an account of

the various collections of lichens in Formosa, though little had been done in the determination of these plants. The list now numbers eighty-one genera and 260 species, mostly collected by Faurie and Asahina. The tropical character of the plants is distinctive, though there are many lacunæ, as, for instance, Graphidaceæ and Chiodectoneæ. The plants of their first list are crustaceous forms, many of them new to science, described with full particulars, microscopic and otherwise.

A. L. S.

Lichenology of Massalongo.—G. B. DE TONI (" L'Opera di Abramo Massalongo," *Commemorazione Secolare di Abramo Massalongo*, 1933, 1–60, 9 pl.). De Toni has outlined the special work done by Massalongo for Lichenology. He has reviewed his system of classification and related that with more recent arrangements. The coloured plates have been determined by A. Zahlbruckner according to more modern nomenclature.

A. L. S.

Monograph of Ionaspis.—A. H. MAGNUSSON (*Goteborgs Botaniska Trädg.*, 1933, 8, 1–47). The lichen genus *Ionaspis* is closely allied with *Aspicilia*, a section of *Lecanora*. It differs in the character of the gonidium—a *Trentepohlia* alga. The species are mostly northern rock dwellers and grow in high altitudes or in the extreme north ; a few species are calcicolous, but the great majority are non-calcicolous. Magnusson relies on microscopic characters of hymenium, spores, etc., as also on the internal coloration of the apothecia. A key is provided and the descriptions are full and clear.

A. L. S.

Umbilicariaceæ.—EDUARD FREY · (*Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz*, IX, Abt. IV, 1933, **2**, i-x, 209–426, 32 text-figs., 8 pls.). Frey has united *Gyrophora* with *Umbilicaria*, and his account of the family deals with the one genus, *Umbilicaria* and, as subgenera, *Lasallia*, *Gyrophoropsis* and *Gyrophora*. Thalline characters in the subgenera are similar, but there are differences in spore characters. Frey outlines the conflicting views as to the systematy, giving his reasons for treating spore characters in this case as subsidiary. He describes the general thalline development—the organs of attachment, the umbilicus, and the rhizinæ, the origin of polyphylly, and the dark coloration, almost black in exposed sunny situations. The anatomy of the thallus with the differences occurring in the different section is also given, and the vegetative methods of increase by breaking off of thalline particles. In describing apothecial development in Gyrophoraceæ he finds that the non-fertile lines that appear on the fructifications may often be due to the closely associated growth of neighbouring apothecia, but the more frequent cause is traced to the thickening of the wall of certain paraphyses which become cellular and brown and thus give rise to the furrowed apothecium. Then follows the description of species with full microscopic details.

A. L. S.

Mycetozoa.

Colloderma oculatum.—JOSEPH ROSS (" Occurrence of *Colloderma* (Lippert) G. Lister in Epping Forest," *Essex Naturalist*, 1933, **24**, 62). This very minute and uncommon Mycetozoon was found in Epping Forest in 1912 near Debden Green. Ross gives an account of the several places where it has been collected since then. It grows chiefly on dead logs—if on living trees it soon disappears owing to water trickling down the trunk. The most recent record (1932) gives the same habitat and locality. It has now been found in a number of places in the Forest, as well as near the original place of discovery.

A. L. S.·

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIA-
TION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY,
MARCH 15TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT,
IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by
the President.

New Fellows.—The following candidates were balloted for and duly elected
Ordinary Fellows of the Society :—

G. Dallas Hanna, Ph.D.	San Francisco.
James Insch.	London.
Stephen John Matthews.	Sidcup.
Kenneth L. Palmer, F.E.S.	Gobowen.

Nomination Certificates in favour of the following candidates were read for
the first time, and directed to be suspended in the Rooms of the Society in the
usual manner :—

As Ordinary Fellows :—

Edward Milton.	Torquay.
Keith Stewart Thompson, M.R.C.S., L.R.C.P.	London.

As Honorary Fellow :—

Sir Herbert Jackson, *K.B.E.*, F.R.S.	London.

Donations were reported from :—

Messrs. Chapman & Hall, Ltd.—

" Practical Microscopical Metallography." 2nd edition. By R. H.
Greaves and Harold Wrighton.

Trustees of the British Museum—

" Index Animalium." Part XXXI. 1932. By C. D. Sherborn.
" Clothes Moths and House Moths. Their Life-history, Habits and
Control." By E. E. Austen and A. W. McKenny Hughes.

Rev. Dingley P. Fuge—

18 Species Slides of Naviculoid Diatoms.

Mr. John A. Long, F.R.M.S.—

120 Species Slides of Diatoms.

Sir Robert Hadfield, Bart., F.R.S., Hon. F.R.M.S.—

Two guineas.

Votes of thanks were accorded to the donors.

The President called on

Dr. R. G. Canti,

who then gave his Lecture Demonstration on

" Living Tissue Cells cultivated *in vitro*,"

illustrated by cinematograph films,

at the conclusion of which a discussion followed, in which the President (Mr. C. Beck), Dr. J. A. Murray, Mr. D. J. Scourfield, and Mr. E. K. Maxwell took part.

A hearty vote of thanks was accorded to Dr. R. G. Canti for his lecture and demonstration.

The following **Papers** were read in title :—

Prof. A. Gandolfi Hornyold, D.Sc., F.Z.S., F.R.M.S.—

" The Otoliths of Eight Eels of the Foiba."

Dr. J. C. Mottram, F.R.M.S.—

" Chromatic Inclusions in the Cytoplasm of Cells after Gamma Radiation, and Changes in the Nucleolus."

Mr. Douglas P. Wilson, M.Sc.—

" A Simple Block Trimmer for the Cambridge Rocking Microtome."

Announcement.—The Secretary announced that the Biological Section would meet in the Pillar Room on Wednesday, April 5th, 1933.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIA-
TION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON ·WEDNESDAY,
APRIL 19TH, 1933, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PAST PRESIDENT,
IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the
Chairman.

New Fellows.—The following candidates were balloted for and duly elected :—

As Ordinary Fellows of the Society :—

Edward Milton.   Torquay.
Keith Stewart Thompson, M.R.C.S., L.R.C.P.   London.

As Honorary Fellow :—

Sir Herbert Jackson, *K.B.E.*, F.R.S.   London.

Nomination Certificate in favour of the following candidate was read for the
first time, and directed to be suspended in the Rooms of the Society in the usual
manner :—

David Henry Graham.   Dunedin, N.Z.

Donations.—The Chairman reported the following valued accessions to the
Society's Collections, and cordial votes of thanks were accorded to the donors :—

Mr. F. Adams, F.R.M.S.—

50 Slides of Kitton's Norfolk Diatoms and 39 Slides of Cleve Diatom
Mounts.

Rev. Dingley P. Fuge—

24 Species Slides of Naviculoid Diatoms.

Mr. S. H. Meakin—

20 Species Slides of Diatoms.

Mr. John A. Long, F.R.M.S.—

117 Species Slides of Diatoms.

Mr. W. H. Gillett, F.R.M.S.—

A Camera Lucida.

The latter instrument is a modification of the well-known neutral tint reflector devised by Beale many years ago, and consists of a ring clip for attachment to the body-tube of the microscope, carrying an adjustable rod parallel to the body with a rod at right angles at the end. The latter is fitted with a carrier to hold plain, tinted, or silvered glasses at varying angles, and is adjustable for focal distance and centration with the eye-piece.

Balance Sheet.—The Chairman then called upon the Treasurer, Mr. C. F. Hill, to present his Financial Report and Balance Sheet for the year ended December 31st, 1932.

FINANCIAL REPORT FOR THE YEAR ENDED 31ST DECEMBER, 1932.

The Income and Expenditure Account shows the accumulated debit balance at December 31st, 1932, of £235 9s. 7d., a decrease of £121 9s. 5d. on the amount brought forward at the corresponding period the previous year.

One new compounded subscription has been received during the year, and the Life Membership Account now stands at £2034 2s. 6d. The investments standing in the Society's Books at £2176 1s. 5d. had a market valuation at the end of the present accounting period of £2579 4s. 10d. It will be remembered that last year the market value of the investments was below the book value, and it is gratifying to be able to record the recovery of the trustee investments.

On the recommendation of the Auditors it has been decided to place the amounts received on account of Admission Fees to Capital Account, as was the practice prior to 1914, when for various reasons these amounts were taken into Income and Expenditure Account.

Considerable economies have been effected in all items of expenditure, decreases being shown on account of rent, sundry expenses, and also in the cost of Journal printing. It must be observed, however, that the long-continued world depression has resulted in a diminished income from the Society's Journal, due partially to the smaller grant from the Royal Society, and to an increase in the number of Empire and foreign institutions which find themselves unable to continue for the time being their annual subscriptions to the Society's Journal, and with regard to the latter, the Council feels that many or all of these will require to complete their sets and renew their subscriptions at a convenient time. Nevertheless, it has been necessary to take cognisance of the resultant decrease in the Society's income and, while continuing to make all possible effective economies, it urges upon Fellows their responsibility and the value of their support in exercising their best endeavours to effect an increase in the Society's income, in order to maintain its honoured position as a leading scientific body.

I have pleasure in expressing my thanks to the Secretaries for their co-operation, and to the Society's Honorary Auditors, Messrs. Thomson McLintock & Co., for their services during the year.

1931. £ s. d.	EXPENDITURE.	£ s. d.	£ s. d.	£ s. d.
249 18 9	To Balance, being Excess of Expenditure over Income at 1st January, 1932 . . .			356 19 0
216 9 11	„ Rent, Lighting, Heating, Telephone and Insurance			166 11 9
350 10 0	„ Salaries, Reporting, etc.			354 0 0
	„ Sundry Expenses—			
	Library Books and Binding, including provision for Work outstanding . .	28 14 0		
	Stationery, Printing, Postages and Sundry Expenses	64 13 3		
	Repairs and Renewals	3 3 10		
	Refreshments at Meeting . . .	9 13 0		
164 2 6				106 4 1
	„ Journal—			
	Expenditure—			
	Printing	653 2 3		
	Editing and Abstracting . . .	199 18 10		
	Illustrating	69 9 3		
	Postages and Addressing . . .	47 4 6		
		969 14 10		
	Less Receipts— £ s. d.			
	Grant from Royal Society . 150 0 0			
	Sales . . . 487 18 11			
	Advertisements . . 95 3 4			
		733 2 3		
376 13 11			733 2 3	236 12 7
27 8 7	„ Depreciation on Furniture			30 2 9
£1385 3 8				**£1250 10 2**

LIABILITIES.	£ s. d.	£ s. d.
I. Capital—		
Being (a) Life Compounded Subscriptions received from 1st January, 1877, to 31st December, 1932 . . . . . .2034 2 6		
(b) Quekett Memorial Fund 100 0 0		
(c) Mortimer Bequest 45 0 0		
(d) A. N. Disney Bequest 100 0 0		
(e) Amounts received in respect of Sales of Books from the Library (surplus to the Society's requirements) . . . 253 12 0		
£ s. d.		
(f) Admission Fees for 1931 . 67 4 0		
Add : Received during 1932 48 6 0		
	115 10 0	
		2648 4 6
II. Loan		200 0 0
Note.—The Hon. Treasurer of the Society has advanced this sum to meet the cost of Publishing " The Microscope and Catalogue of Instruments." The Loan is made to the Society free of interest.		
III. Sundry Creditors—		
Subscriptions paid in advance . . . 31 5 6		
Journal Subscriptions paid in advance . . 107 14 7		
On Account of Journal Printing, etc. . . 273 9 1		
		412 9 2
		£3260 13 8

London, 16th March, 1933. We have examined the Books and Accounts of the Royal Microscopical Society for the year to 31st December, 1932, and have found the transactions correctly recorded and sufficiently vouched.

In our opinion the foregoing Balance Sheet is properly drawn up so as to exhibit

CYRIL F. HILL, Hon. Treasurer.

1931.				INCOME.			£	s.	d.	£	s.	d.
£	s.	d.										
			By Subscriptions	.	.	.	813	17	4			
			,, Subscriptions for 1932 unpaid	.	.	40	14	6				
858	4	6								854	11	10
52	6	6	,, Donations and Sundry Receipts	.	.	.				45	16	6
117	13	8	,, Interest on Investments and Deposit Account							114	12	3
			,, Balance, being Excess of Expenditure over									
356	19	0	Income at 31st December, 1932	.	.					235	9	7

£1385	3	8		£1250	10	2

31ST DECEMBER, 1932.   **Cr.**

ASSETS.	£	s.	d.	£	s.	d.
I. *Furniture and Equipment*—						
As at 31st December, 1931	242	10	0			
Additions during year	58	17	6			
	301	7	6			
Less : Depreciation at 10 %	30	2	9			
				271	4	9
II. *Investments at Cost*				2176	1	5
£400 London & North Eastern Railway Co. 3% Debenture						
Stock.						
£500 Nottingham Corporation 3% Irredeemable Deben-						
ture Stock.						
£915 11s. 4d. India 3% Stock.						
£150 Metropolitan Water Board " B " Stock.						
£612 London Midland & Scottish Railway Co. 4% Pre-						
ference Stock.						
£200 New South Wales 5¼% Loan, 1947–57.						
£421 1s. 0d. 3½% Registered War Stock.						
£200 5% Conversion Loan, 1944–64.						
Note.—The Market Valuation of the above investments						
at 31st December, 1932, was £2579 4s. 10d.						
III. " *The Microscope and Catalogue of Instruments* "—						
Amount expended on publication to date, less sales in						
previous years	200	0	1			
Less Sales for 1932	12	4	9			
Note.—The Hon. Treasurer of the Society has given his				187	15	4
personal guarantee to meet any part of this						
expenditure that is not recovered by means						
of Sales of the Publication.						
IV. *Sundry Debtors*—						
Subscriptions unpaid, amounts due in respect of Journal						
Sales, Advertisements, etc.				106	0	11
V. *Cash at Bank and in Hand*—						
At Bank on Deposit Account	200	0	0			
At Bank on Current Account	81	5	11			
In Hand	2	15	9			
				284	1	8
VI. *Income and Expenditure Account*—						
Balance, being excess of Expenditure over Income as						
per Account attached				235	9	7
				£3260	13	8

a true and correct view of the state of the Society's affairs, subject to it being noted that
no account has been taken of the value of the Society's Library, Stock of Journals
and Collection of Instruments (valued for insurance, together with the Furniture and
Equipment at £7000).

The number of Fellows on the Roll of the Society at December 31st, 1932, is as follows :—

Number of Fellows on the Roll at December 31st, 1931 500
Fellows elected during year 23
Fellows reinstated during year 5   28
                                     528
Fellows resigned or removed during year . . 26
Fellows deceased during year 12   38
                                     490

The total is made up of :—

(a) Ordinary Fellows 450

of whom *415 have paid current sub-
scription
22 are one year in arrear
13 are two years in arrear
    ——
450

(b) Life Fellows—

Number on Roll at December 31st, 1931   27
Elected during year 1
            —
            28
Deceased during year . . . 2   26

(c) Honorary Fellows 14   490

* In addition, 11 Fellows paid their current year's subscription previous to death or resignation.

On the motion of Mr. C. F. Hill, seconded by Mr. S. C. Akehurst, the Report and Accounts were unanimously approved and adopted.

Mr. C. H. Caffyn moved, and Mr. H. Taverner seconded the following resolution, which was carried with acclamation :—

"That the best thanks and appreciation of the Fellows be conveyed to Messrs. Thomson McLintock & Co. for their valued services to the Society as Honorary Auditors during the past year."

Papers.—The following communication was then read :—

Mr. John Smiles, A.R.C.S., F.R.M.S.—

"Dark-ground Illumination in Ultra-violet Microscopy."

A discussion followed, in which Mr. J. E. Barnard, Mr. B. K. Johnson, Mr. J. Rheinberg, and Mr. J. Smiles took part.

The following paper was communicated by Dr. Clay :—

Dr. Reginald S. Clay, B.A., D.Sc., F.R.M.S., and Mr. Thomas H. Court—

"Note on the Introduction of the Field Lens in the Microscope ; Dr. Henry Power and his Letters."

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The Secretary announced that the Biological Section would meet in the Pillar Room on Wednesday, May 3rd, 1933.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MAY 17TH, 1933, AT 5.30 P.M., PROF. R. RUGGLES GATES, M.A., Ph.D., LL.D., F.R.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

David Henry Graham.   Dunedin, N.Z.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

Rev. Wallace H. Cauldwell.   Halifax.
Arthur Samuel Newman.   London.

Donations were reported from :—

Messrs. Methuen & Co., Ltd.—

"Cytological Technique." By John R. Baker.

Prof. S. R. Kashyap—

"Liverworts of the Western Himalayas and the Panjab Plain." Part II and Supplement to Part I. By S. R. Kashyap.

Liverpool University Press—

"The Marine Plankton." By James Johnstone, Andrew Scott, and Herbert C. Chadwick.

Mr. Sydney T. Klein, F.R.M.S.—

"The Garden of Enchantment." By Sydney T. Klein.

Mr. Sydney H. Robinson, F.R.M.S.—

"Plankton Collected by the Swedish Expedition to Spitzbergen in 1898." By P. T. Cleve.

9 papers on the Danish Expedition to North-East Greenland, 1906–1908. Various authors.

3 papers on Nordisches Plankton. Various authors.

Mr. John A. Long, F.R.M.S.—

82 Species Slides of Diatoms.

36 Slides of Diatoms mounted in Pleurax (R.I. 1·90), illustrating Dr. G. Dallas Hanna's paper on "An Alcohol-soluble Resin of High Refractive Index," for distribution at the Meeting.

Rev. Dingley P. Fuge—

26 Species Slides of Naviculoid Diatoms.

Dr. C. L. Huskins—

£7 10s.

Hearty votes of thanks were accorded to the donors.

Papers.—The following communications were then read :—

Mr. F. Martin Duncan, F.R.P.S., F.Z.S., F.R.M.S.—

"Demonstration of Photo-micrography with Infra-red Rays."

Mr. J. E. Barnard, F.R.S., F.R.M.S., and Mr. F. V. Welch, F.R.M.S.—

"Some Further Examples of Dark-ground Ultra-violet Microscopy."

and in the ensuing discussion the following gentlemen took part : Prof. Gates, Prof. Hindle, Mr. Rheinberg, and Mr. Smiles. Mr. Barnard and Mr. Martin Duncan responded.

Hearty votes of thanks were accorded to the authors of the foregoing communications.

The following **Papers** were read in title :—

Sukh Dyal, M.Sc., and Vishwa Nath, M.Sc., Ph.D., F.R.M.S.-

"On the Nature of the Yolk Nucleus of Spiders."

L. T. Fairhall, M.A., Ph.D., F.R.M.S., and Ruth G. Howard—

" A General Method of Quantitative Microchemical Analysis. I. The Determination of Calcium."

G. Dallas Hanna, Ph.D., F.R.M.S.—

" An Alcohol-soluble Resin of High Refractive Index."

A. Gandolfi Hornyold, D.Sc., F.Z.S., F.R.M.S.—

" The Otoliths of Eight Small Yellow Eels from the Etang de Thau."

C. Leonard Huskins and E. Marie Hearne—

" Meiosis in Asynaptic Dwarf Oats and Wheat."

W. A. Macfadyen, *M.C.*, Ph.D—

" A Note on the Foraminiferal Genus *Bolivinopsis* Yakovlev."

J. C. Mottram, F.R.M.S.—

" Changes in the Non-Dividing Nucleus following Gamma Radiation."

F. J. Myers, F.R.M.S.—

" *Cephalodella crassipes* (Lord) and *Dorria dalecarlica*, Gen.n., Sp.n."

Douglas P. Wilson, M.Sc.—

" An Improved Method of Orientating Minute Specimens for Section Cutting."

Announcements.—The Secretary made the following announcements :—

The next Ordinary Meeting of the Society will be held on Wednesday, October 18th, 1933.

The next Meeting of the Biological Section will be held on Wednesday, November 1st, 1933.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 21st to September 16th, 1933.

The Proceedings then terminated.

NOTICES OF NEW BOOKS.

Cytological Technique.—By JOHN R. BAKER, M.A., D.Phil. 1933. xi + 131 pp., 3 text-figs. Published by Methuen & Co., Ltd., 36, Essex Street, London, W.C.2. Price 3s. 6d. net.

The Marine Plankton, with Special Reference to Investigations made at Port Erin, Isle of Man, during 1907–1914. A Handbook for Students and Amateur Workers.—By JAMES JOHNSTONE, D.Sc., ANDREW SCOTT, A.L.S., and HERBERT C. CHADWICK, A.L.S. 194 pp., 41 tables, 20 plates. Published by the University Press of Liverpool, Limited, and Hodder & Stoughton, Ltd., London. Price 12s. 6d. net.

Watson's Microscope Record. No. 29.—May, 1933. 24 pp., illustrated. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

An Index to the Genera and Species of the Diatomaceae and their Synonyms, 1816–1932.—Compiled by Frederick Wm. Mills, F.L.S., F.R.M.S. Part I, A. May, 1933. 74 pp. Published by F. W. Mills, Milton Damerel, North Devon; and (for Colonial and foreign subscribers) by Wheldon & Wesley, Ltd., 2, 3 and 4, Arthur Street, New Oxford Street, London, W.C.2. Price by subscription, 10s. per part.

XII.—DARK-GROUND ILLUMINATION IN ULTRA-VIOLET MICROSCOPY.

535.822.5.

By JOHN SMILES, A.R.C.S., F.R.M.S.

(*Read April 19th*, 1933.)

FIVE TEXT-FIGURES.

THE production of a dark-ground illuminator for use with ultra-violet light is a new development in microscopy that has hitherto only been attempted for work on the filtrable virus problem at the National Institute for Medical Research. The first condenser produced was of the bispherical reflecting type, which is superior to any other in the perfection of its correction, but is quite unsuitable for ultra-violet work because of its low light-transmission. The object of this paper is to describe a condenser of new design which transmits nearly the whole of the light emitted by a suitable spark source, and which enables work on the resolution of small bodies to be achieved that has proved to be impossible by any other available method.

Seidentopf (1929) has shown that by designing such a system to secure an anastigmatic image a high degree of spherical correction may be obtained. To effect this the astigmatism produced by the first reflecting surface is removed by the second. Elsewhere (1924) it has been shown that, for a prescribed degree of spherical correction, the intensity of the light in the image plane of the condenser is considerably reduced when the minimum numerical aperture of the annular illuminating cone is increased. It is true that the aperture of the object-glass may also be increased so as to utilize a larger cone of light scattered by the object, but this does not offset the loss in illumination due to the above-mentioned alteration in the illuminator. On the other hand,

the real gain, and a very important one, is an increase in resolution provided the brilliancy of the light source is sufficiently high to render the object visible.

In the usual method, where a stop is introduced behind a high-power object-glass to limit its aperture, the difference between the minimum aperture of the illuminating cone and the effective aperture of the objective is considerable, and may reach a value of 0·15 in order to obtain a dark-ground image free from the effects of stray light. This value is reduced to 0·05 in the case of the highly corrected high angle bispherical illuminators produced by Messrs. R. and J. Beck for use with unstopped objectives having numerical apertures of 1·20 and 1·27. To obtain this small " clearance " they found that it was necessary to limit the apertures of objectives to be used with them by mounting a stop between two of the lens components, rather than by relying on the back focal plane stop. It is clear that the narrow range between the minimum aperture of the illuminator and the effective aperture of the objective must impose severe restrictions on the amount of spherical aberration in the former, otherwise stray light would tend to enter objectives of short working distance when the condenser is adjusted to obtain maximum illumination of the object.

It will be noted that the objective apertures mentioned fall short of those which can be effectively used for transmitted light work, and it might be thought that, provided sufficiently brilliant sources of light can be obtained, there is still room for a considerable improvement in resolution by dark-ground methods. In many biological preparations suitable for observation by " dark-ground " the objects are immersed in a watery medium the refractive index of which is considerably below that of the slide. This means that the maximum numerical aperture of the illuminating cone will be limited by total reflection at the upper surface of the slide and will be numerically equal to the refractive index of the medium. Further, owing to the contrast in a dark-ground image being very much greater than in a transmitted light one, the type of object plays a greater part in determining the usefulness of the method and, as a result, puts a limit to it. To obtain a perfect image it is essential that all planes of the object shall lie within the focal range in the object space, and since this range decreases with increase of numerical aperture the types of object suitable for examination must be correspondingly less in size. Thus, so far as visual work is concerned, the desirability of carrying out further improvements must be largely a question of expediency.

Since virus bodies are below the limit of resolution by any visible method, the problem of determining their microscopic appearances has been attacked by making use of the fact that the resolving power of a microscopic objective is inversely proportional to the wave-length of the light used. Further, since the introduction of the high angle illuminator by R. and J. Beck proved to be a definite advance on anything that had been done previously so far as dark-ground illumination was concerned, it was thought advisable to attempt to obtain dark-ground photographs by means of ultra-violet light.

The first condenser made for use with these short wave-lengths was constructed by the above firm and was similar in form to the type just described. The reflecting surfaces were of polished magnalium, which has a high reflecting power in the ultra-violet region. Two front lenses of crystalline quartz were supplied with it so that two aperture values could be used. The higher of these, however, did not transmit sufficient ultra-violet energy to be of any real service. With the lower value the aperture of the quartz objective, which had not been specially constructed for dark-ground work, had to be cut down by a stop placed behind the lens in order to obtain a perfect dark-ground effect. The correction of the system was of a high order, the light being concentrated on a very small area of the object, although the angular illumination was extremely limited.

Tests were carried out upon various organisms and it was found that with the lower numerical aperture stop an excellent result could be obtained in from 10 to 20 minutes in the case of large organisms. This, however, is an exposure which, from a practical point of view, is too long. The source of light used is the spark and therefore the output of radiant energy is limited, so that no alteration in the brilliancy could be effected which would result in a sufficiently large reduction of the time of exposure.

In practice, an image of the spark in the wave-length used is focused a short distance in front of the first reflecting surface, and, by rotating the illuminating system about a vertical axis which passes through the centre of the last prism face of the dispersing system, the required wave-length can be brought into use. The distribution of the light in the image depends upon the electrical conditions which generate the source and upon the width of the spark gap. If the latter be too wide, there will be two areas between the poles where the intensity is a maximum. By reducing the width of the gap these two areas may be made to overlap, the image becoming more or less circular in form, and the intensity being a maximum in the centre and falling off in all directions towards the outermost zones. Thus the light which is cut off by the bispherical form of illuminator originates in that part of the source where the intensity is greatest.

In order to reduce the exposures to workable dimensions, it was decided that a radical departure from the existing types of illuminators would be necessary and that use would have to be made of the light which is lost by stopping out the central portion of the incident light to form the hollow cone. To accomplish this, the first reflecting surface must be of such a form that the whole of the light is reflected towards the second, which, in turn, must direct it to a focus upon the axis of the system. After many experiments, the method ultimately decided on was to replace the first annular spherical surface of the bispherical reflector by a polished cusp or cone consisting of metal having a high reflecting power for the wave-length used. The apex of such a reflector must point towards and be co-axial with the illuminating beam. The form of the second will be dependent upon that of the first.

14—2

As in the case of the Beck illuminator, the metal chosen was magnalium. With the cusp a parallel beam of light, co-axial with its axis, is reflected so as to form a line focus which takes the form of a circle concentric with, and in a plane perpendicular to, the axis of the reflector. To focus the whole of the light upon the axis the second reflecting surface takes the form of an
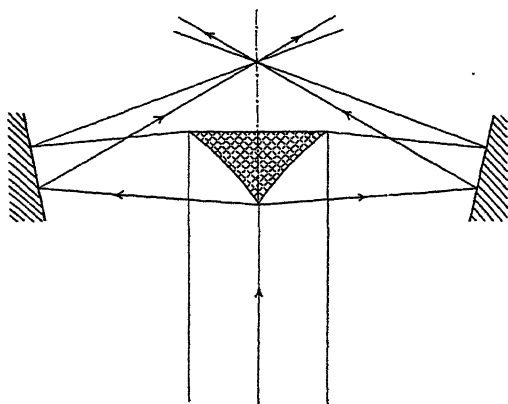
FIG. 1.

internal cone, the axis of which coincides with the axis of the cusp. Fig. 1 indicates the arrangement of the reflecting surfaces and the paths of the central and marginal rays of a parallel beam after reflection at the first
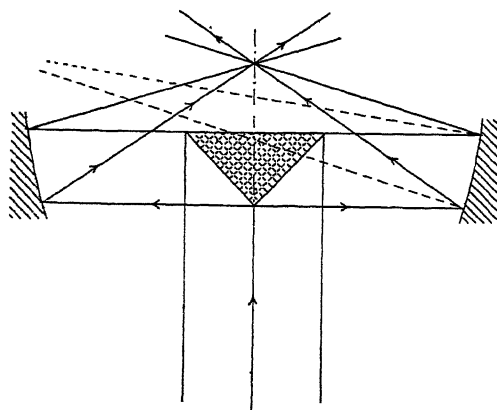
FIG. 2.

surface. The obliquity of the focused beam to the axis may be increased or decreased by respectively decreasing or increasing the angle of the cone.

When the cusp is replaced by a cone the reflected beam does not converge to a focus. The second reflecting surface must, therefore, produce the necessary convergence as well as direct the light towards a focus on the axis of the cone. Fig. 2 shows the arrangement of the surfaces and the paths

of rays. The form of the second reflecting surface is that generated by part of the shorter arc of a circle revolving about the chord which cuts it off.

Although these surfaces are aspherical, the second reflector can be produced with sufficient approximation to an ideal optical surface. The first surface, in each case, however, proved to be difficult to polish whilst maintaining its form. A considerable portion of the apex always became rounded off before the degree of polish necessary was attained. This, of course, defeats the object of the design because the rounded portion has to be cut away, and so a part of the radiant energy from the brightest portion of the source is lost. Another difficulty was encountered when designing the mounts for the surfaces. The first reflector had to be mounted on a disc held in position
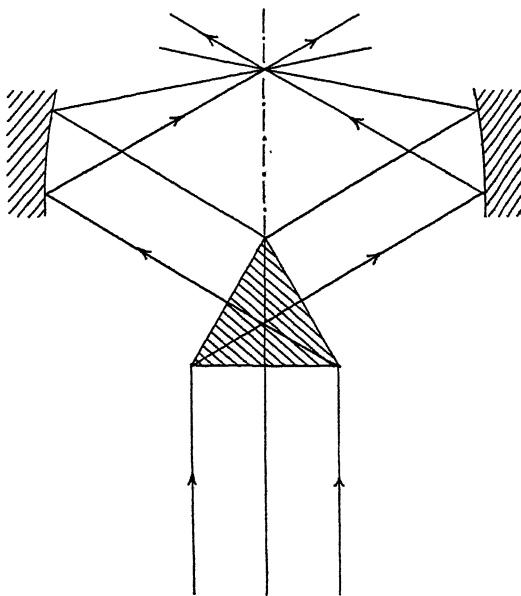
Fig. 3.

by three metal arms which cut off a certain amount of light, whilst considerable difficulty was experienced when adjusting the two surfaces so that they were co-axial.

The difficulties just described were minimized by a design similar to that shown diagrammatically in fig. 3. The first metal reflector is replaced by a 60° quartz cone. A parallel beam of light passes normally through the base of the cone and each ray, totally reflected at the conical face, emerges normally from the opposite side of the cone. The second reflector consists of a polished surface of magnalium similar to that described for use with the metal cone. By making the cone of quartz a better polished surface can be produced. The tendency to distort the surface at the apex is much reduced, so that greater advantage can be taken of the energy of maximum intensity emitted at the centre of the source. Added to this there is a gain in intensity due to

the rays being totally reflected. A centred iris diaphragm is placed close to the image of the spark gap, and, by reducing the aperture of this to cut off the outer part of the image, the minimum aperture of the illuminating cone is increased without serious loss of intensity in the dark-ground image. In the arrangement shown in figs. 1 and 2 no such advantage could be gained, as it would only result in a reduction of the maximum numerical aperture, the minimum value remaining the same. Stress is sometimes laid on the dependence between the spherical correction of the illuminating system and the perfection of the dark-ground image. The unavoidable lack of correction in this type of condenser has not, in so far as resolution is concerned, been a source of trouble, the only drawbacks being that the light is not concentrated in as small an area as would be the case in a properly corrected system, and the difference between the minimum angle of the illuminating beam and the maximum effective aperture of the objective is larger than would otherwise be the case. The cone is held round the rim of the base by a flat metal ring which does not interfere with the illuminating beam and which allows for easier centration of the two reflecting surfaces. By using this system photographs of even the smallest known living organisms can be obtained in from 10 to 20 seconds.

It is of interest to consider here the question of resolution by dark-ground methods and the validity of the Abbe theory. From this theory the deduction is made that if an object is illuminated by a narrow beam of light of such an obliquity that no direct light enters the objective (a condition necessary when producing perfect dark-ground images, but not of necessity always producing such images, as will shortly be shown) resolution cannot be obtained unless two consecutive orders of diffraction spectra enter the objective. For the best results, that is to say for the highest possible degree of resolution, these will be the first and second orders. It is claimed that, if an objective of numerical aperture A can just resolve a particular object by transmitted light, the numerical aperture of a " dark-ground " condenser must be 3A in order that the same may be resolved by dark-ground. A number of observers, however, though their statements have been challenged, have stated that detail in such diatoms as *Pleurosigma angulatum* and *Amphipleura pellucida* has been resolved by " dark-ground " under conditions which go to disprove the above deduction and that as a result the Abbe theory is untenable.

J. E. Barnard has shown before this Society photographs of the latter taken with ultra-violet light and using the dark-ground illuminator which has just been described. The regular distribution of the so-called " dotted " structure, and the definite rectangular shape of the " dots " which are exhibited in these photographs, leave no room for doubt as to the capability of resolving these " dots " under the conditions employed. Yet, if the above deduction were true when applied to this object, the structure shown could not have been resolved even with the short wave-length employed.

The diatom was mounted in water, which has a refractive index of 1·365

for a wave-length of 0.275μ, the wave-length employed when taking the photographs. Supposing a narrow beam of this wave-length, at right angles to the axis of the optical system, were used to illuminate the diatom the illuminating cone would have a numerical aperture of 1.365. The maximum resolution would, according to the above, be equal to that obtained when using an objective of 0.455 numerical aperture, and the smallest separation between " dots " which could be resolved would be 0.31μ. Actually the maximum aperture of the illuminator did not exceed 1.32, so that the value of this separation is too low. Seidentopf (1928) gives the separation of the " dots " in the direction perpendicular to the length of the diatom as from 0.25μ to 0.28μ, which means that, by the above reasoning, the separation of the dots is at least 0.03μ too small to allow them to be resolved. The appearance, which one should expect to see, is a series of parallel lines perpendicular to the length of the diatom.

It would appear that this is further evidence of the untenability of the Abbe theory, but a little consideration will show that it is not the theory but the deduction which is untenable when applied to a natural object such as this diatom. The objects used to demonstrate the theory are periodic in character, comparable to the ideal grating which consists of equally spaced opaque strips separated by translucent ones. Whether the object be illuminated by direct light or by light of such obliquity that the direct light misses the objective, the light which enters the objective must emanate from the translucent spaces. If no account is taken of light scattered at the edges of the opaque strips, when oblique illumination is used, the image formed by diffracted light only will, if the object is resolved, be of the nature of a transmitted light image and will bear no resemblance to a dark-ground one. The resolution obtained is in accordance with the deduction and may be verified experimentally.

Like the grating the structure of *Amphipleura pellucida* is periodic in character, but unlike it no element of it is opaque. Light is scattered from the material forming the structure when illuminated obliquely and the whole aperture of the objective collects it to form a dark-ground image. Whether or not there is a phase relationship between the beams scattered by each element the resolution will be of the order one would expect on theoretical grounds for such an aperture. Since the structure is capable of producing diffraction effects by transmitted illumination, such effects will be present when it is illuminated obliquely, and these will produce a general illumination over the dark-ground image. The effect of this upon contrast will depend upon the intensity of the diffracted light ; the greater the intensity the less the contrast. In a number of photographs, where portions of the " dotted " structure are in perfect focus, there is evidence of diffracted light.

In photographs of other objects there is definite evidence that the order of resolution is greater than that which is expected on theoretical grounds. This is the case in photographs of organisms containing granules which are separated by distances less than the theoretical value. The same is true in

the case of photographs of smoke and granular silver deposits on quartz slides. It is probable that the unresolvable particles act as true scatterers and that the variation in amplitude over the surface of each scattered wave may account for this. If this is so, then the use of shorter wave-lengths will offer further advantages in this type of work since the intensity of scattered light varies inversely as the fourth power of the wave-length.

It has been mentioned that the success of the method depends upon the nature of the object to be photographed. So far as size is concerned the determining factor will be the depth of penetration (i.e., the focal depth in the object space) of the objective. This is given by the formula $S = \dfrac{0 \cdot 5\lambda}{N \sin^2 U/2}$ where λ is the wave-length used, N the refractive index of the medium in which the object is immersed, and U the semi-angle of the cone of rays entering the objective. Thus, with increase of numerical aperture, the depth of penetration decreases and *vice versa*. The perfection of the image, therefore, depends upon whether or not the entire depth of the object lies within the
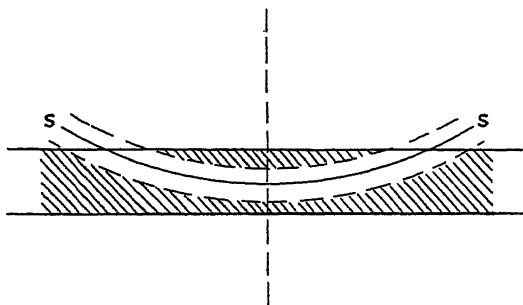
FIG. 4.

focal range. Referring to fig. 4, if an objective is so adjusted that the surface SS is in perfect focus, and if the surfaces represented by the dotted lines indicate the extreme limits on either side of SS such that rays from any point on either of these are brought to a focus with a path difference not greater than $0 \cdot 25\lambda$ (the Rayleigh limit), then all planes of the object will be sharply in focus. Objects lying wholly, or partly, in the shaded area between the slide and cover-glass will appear out of focus and will impair the image of objects lying within the focal range immediately above or below. In the figure the focal range is shown as a curved strip. This is the case in the type of lens used, and, where objects on or near the axis are sharply in focus those near the outer part of the field may not be so. This is very apparent when the film of medium between the slide and cover-glass is extremely thin. When the central part of the field is slightly out of focus the curvature of the object planes may be made use of when determining which way the lens must be moved in order to arrive at the best position for a good axial image.

J. E. Barnard has found that when photographing viruses it is necessary that the film between the cover-glass and the slide must be so thin that the

virus bodies may virtually be considered to be in contact with the lower sur-
faces of the cover-glass. Whenever this was not so the quality of the image
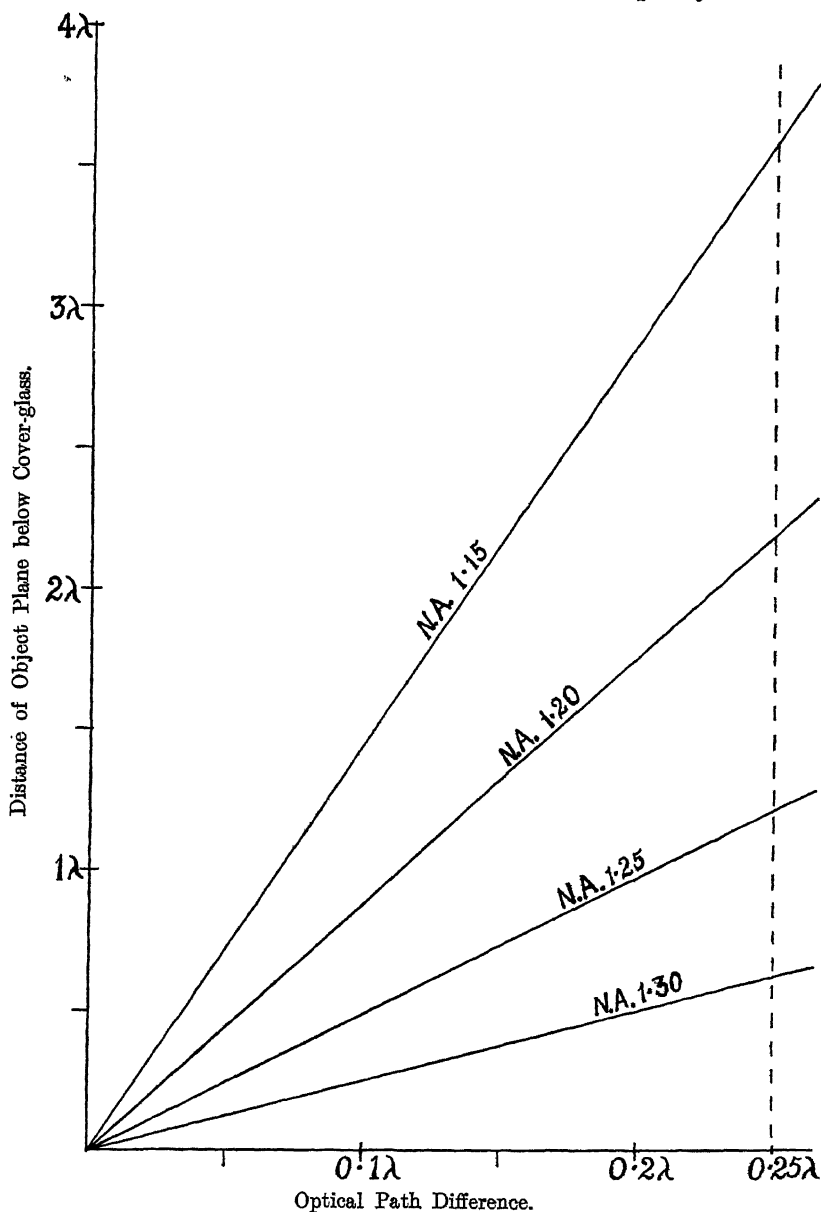
FIG. 5.

was affected. This is accounted for by the fact that the objects are immersed
in a medium having a refractive index which is considerably lower than that

of the fused quartz cover-glass. One of the conditions, formulated by A. E. Conrady, necessary for the production of a perfect image requires that the optical path difference between the actual wave surface converging on the image point and the ideal spherical wave shall be no greater than 0.25λ (the Rayleigh limit). The optical path difference along a ray traced through the complete system is obtained by adding together the difference produced at each surface. If the image is fixed by specifying the tube length the change in the total optical path difference by altering the index of the medium in which the object is immersed will be that which occurs at the lower surface of the cover-glass, and will be proportional to the distance of the object point from the cover-glass. Fig. 5 shows the optical path difference introduced into the marginal ray when the position of an object point immersed in water is altered relative to that of the cover-glass. It is assumed that the objective is a homogeneous immersion system for a wave-length of 0.275μ, and that for each position of the object it has been adjusted to give as perfect an image as possible in the selected image plane. The vertical dotted line represents the Rayleigh limit. If, for a particular aperture, all planes in an object are to be in focus, the distance between the lower surface of the cover-glass and the lowest plane in the object must not be greater than that indicated by the intersection of the dotted line and the curve for that aperture. It might be thought that planes outside this range could be sharply focused by suitably altering the image-distance, but, although this is so in principle, it would be found to be impracticable when applied to ultra-violet dark-ground work.

DISCUSSION.

1. A dark-ground condenser, for use with ultra-violet light, has been described which enables photo-micrographs to be taken with objectives of the highest available numerical aperture. Such a condenser is essential for work on virus and other small bodies, and has made it possible to determine the size and form of organisms the size of which is below the limit of resolution with visible light.

2. Some of the advantages of spherical surface reflecting condensers are discussed and their limitations when used with ultra-violet light are indicated.

3. Certain theoretical aspects of dark-ground illumination are considered in relation to resolving power in the microscope. It is suggested that resolution can be equal to that obtained by any other method of illumination.

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XIII.—CHANGES IN THE NON-DIVIDING NUCLEUS   576. 311.
FOLLOWING GAMMA RADIATION.

By J. C. Mottram.

(From the Research Laboratories of the Mount Vernon Hospital, Northwood, and the Radium Institute, London.)

(*Read May* 17*th,* 1933.)

Five Text-Figures.

In an investigation upon the action of radiation on non-dividing nuclei the following structures require consideration : the nuclear membrane, the linin network, the granules of chromatin, the nucleo-plasm, and the nucleolus.

In previous papers (1926–1927) it was shown that after radiation the nucleo-plasm, or hyalo-plasm, is greatly increased, both when the Infusorian, *Colpidium colpoda,* was irradiated and when Jensen's rat sarcoma was used. In the case of Colpoda this effect was a direct one, and not the result of an intervening abnormal mitosis, since mitosis was inhibited by the radiation and had not occurred. Likewise the results obtained with Jensen's rat sarcoma did not suggest that this effect was in any respect indirect.

Similar findings have now been obtained with bean roots, using gamma radiation as shown in figs. 1, 2, and 3.

It is evident that these large nuclei occurring after radiation have a greatly increased content of nucleo-plasm, the chromatin granules not being correspondingly increased nor, as will be seen later, the linin network ; they are therefore abnormal nuclei and not to be confused with the occasional large but normal nuclei which occur over long periods of time in tissues which have been irradiated, and which probably result from abnormal mitoses in which some cells come to contain greatly increased numbers of chromosomes. The increase in size of the nuclei here referred to occurs within a few days after radiation and affects the majority of the radiated nuclei.

With regard to the nuclear membrane, in the case of Colpoda it was very clearly shown (1926) that this was stretched when the nucleo-plasm was increased in amount. The present observations with bean roots do not demonstrate this stretching, though, of course, it must occur. Observations on the linin network, however, clearly indicate that it has been distended by the increased nucleo-plasm. As shown in fig. 4, it is very open-meshed.

Dealing next with the chromatin content of the nucleus, this consists of granules attached to the linin network, which are stainable in many ways.

The most specific stain is Feulgen's, which depends upon the Schiff reaction for an aldehyde group, thus picking out nucleic acid which is a component of chromatin. It has the disadvantage that fine details of structure are not so well seen, as, for instance, with Heidenhain's hæmatoxylin, which, however, is not specific. With iron-hæmatoxylin the linin network is also stained when the section is very lightly differentiated, and, further, whilst with slight differentiation all the chromatin granules are stained, with high differentiation only the larger granules retain the stain. These varying effects of differentiation are shown in fig. 5.
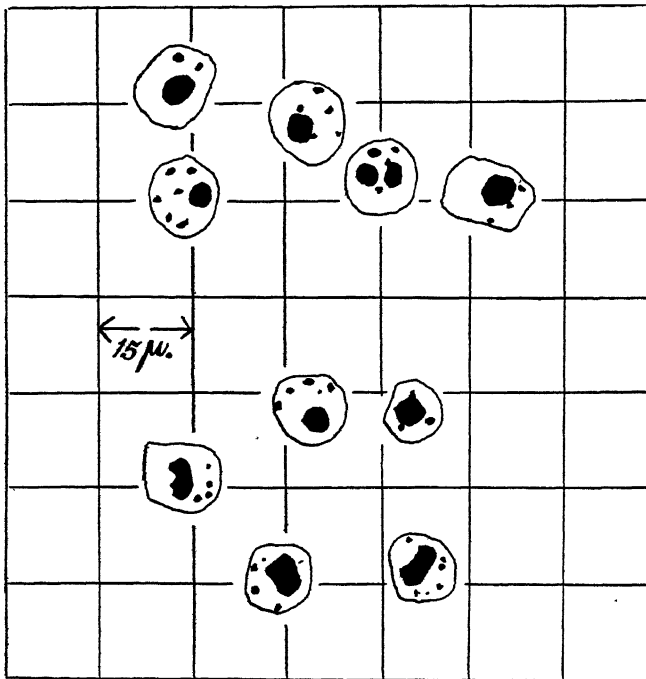
FIG. 1.—The figure shows drawings of optical sections of five radiated (upper) and five normal (lower) nuclei from two root tips, fixed in Bouin's solution, embedded, cut, stained with iron-hæmatoxylin and differentiated, side by side in the same vessels and on the same slide. The radiated root had received, 24 hours previously, 4 hours' gamma radiation from an applicator of 60 m.grms. radium, area 4 sq. cms., screen 3 mm. lead, distance 1 mm. from root tip. Note that the radiated nuclei are a little larger than the control, and also the nucleoli; on the other hand, the chromatin granules are not appreciably different either in size or numbers.

In order, therefore, to compare radiated and control nuclei as regards their content of chromatin, the root tips must be treated side by side as described in the note to fig. 1. Thus were treated the nuclei drawn in figs. 1, 2, and 3, where it is seen that the content of chromatin in the radiated nuclei is not appreciably different from the controls. At first glance, especially in fig. 2, it might be concluded that the radiated nuclei contained less chromatin, but on close examination it is evident that this effect is because the radiated

nuclei are very much larger than the control, and therefore their chromatin is more dispersed. Specimens were also stained with Feulgen's method, and likewise showed no differences as regards chromatin content.

There is another important reason why the chromatin in radiated nuclei appears to be reduced. Under high powers of the microscope, as in figs. 1, 2, and 3, only views of optical sections are obtained, the chance, therefore, of finding granules of chromatin in focus is much less when they are dispersed through a large radiated nucleus than through a small normal one. This difficulty is overcome by counting the granules of chromatin in sets of nuclei ; such counts were made from the specimens from which figs. 1, 2,
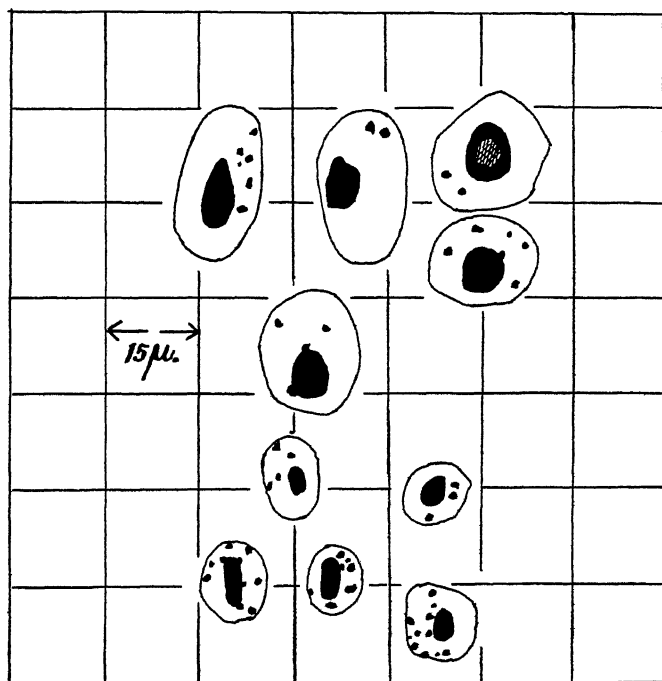
Fig. 2. shows similar drawings. In this case the five upper nuclei had been radiated for 4 hours 2 days previously. Note that the radiated nuclei and nucleoli are very much larger than the controls, and that the chromatin granules appear to be less numerous than in the controls.

and 3 were drawn, and the results are given in the following table, where it is seen that the content in chromatin of these nuclei is very similar.

There is a further reason why sections of radiated tissues appear to contain less chromatin than normal : because mitosis is held up. The nuclei not only cease to pass into mitosis, but evolution ceases at an earlier period when an accumulation of chromatin is taking place in the nucleus as a preliminary to the formation of the spireme (1933). It is the absence of these nuclei about to divide and rich in chromatin which gives sections of irradiated tissues the appearance of being deficient in chromatin. When, however, as

has been seen, all precautions are taken in order to make a fair comparison between irradiated and normal nuclei, then no appreciable difference in content of chromatin is found.
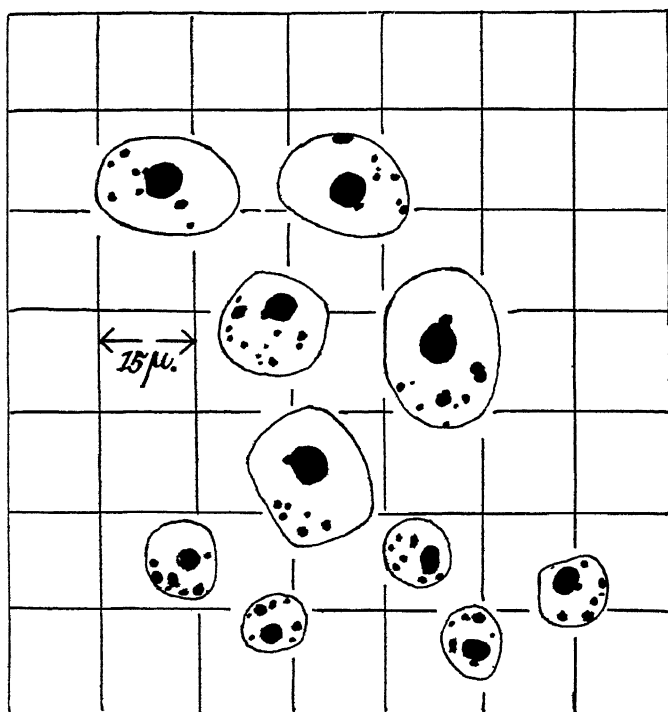
FIG. 3 shows similar drawings. The radiated nuclei had received 4 hours' gamma radiation 3 days previously. Note the further enlargement of the radiated nuclei and nucleoli, whilst the content of chromatin remains unaltered.

TABLE I.

CHROMATIN GRANULES IN TWENTY NUCLEI.

		Average No. of chrom. granules.
Control ..	9, 10, 10, 11, 11, 12, 13, 15, 15, 15, 15, 15, 16, 16, 16, 16, 17, 17, 19, 20.	14·4
Radiated 1 day previously.	9, 10, 11, 13, 13, 14, 14, 14, 14, 14, 15, 15, 15, 15, 16, 16, 17, 18, 19, 20.	14·6
Control ..	9, 10, 10, 10, 11, 11, 12, 13, 13, 14, 14, 14, 15, 15,16,16, 16, 17, 19, 24.	13·9
Radiated 2 days previously.	7, 8, 9, 11, 12, 13, 14, 14, 14, 14, 15, 15, 15, 15, 17, 18, 18, 19, 19, 24.	14·5
Control ..	10, 11, 12, 12, 13, 13, 13, 13, 14, 14, 14, 15, 15, 16, 17, 17, 17, 18, 18.	14·3
Radiated 3 days previously.	9, 11, 11, 12, 12, 12, 13, 13, 16, 16, 16, 17, 17, 17, 17, 18, 18, 19, 20, 25.	15·4
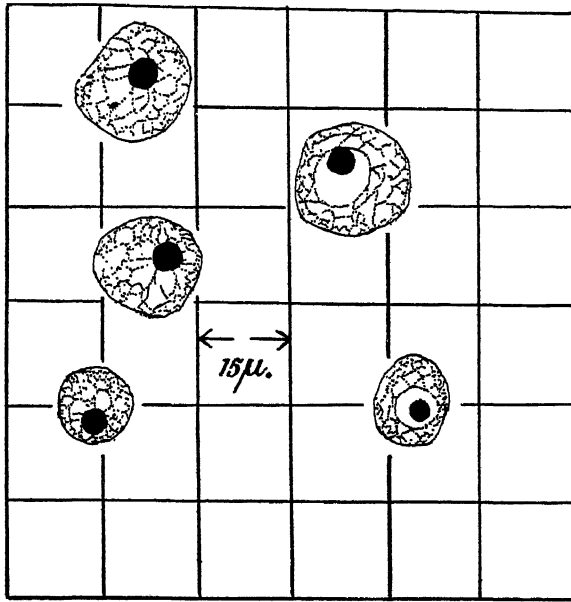
FIG. 4 shows three irradiated and two normal nuclei from the same root tips as in fig. 3, stained by Auerbach's method; the chromatin granules (stained green) have been omitted in the drawings, leaving only the linin network (stained red). In two of the nuclei peri-nucleolar vacuoles are seen, indicating that the linin network was not attached to the nucleolus at the time when the material was fixed in Bouin's solution. For further information with regard to this common occurrence, see paper 1933.
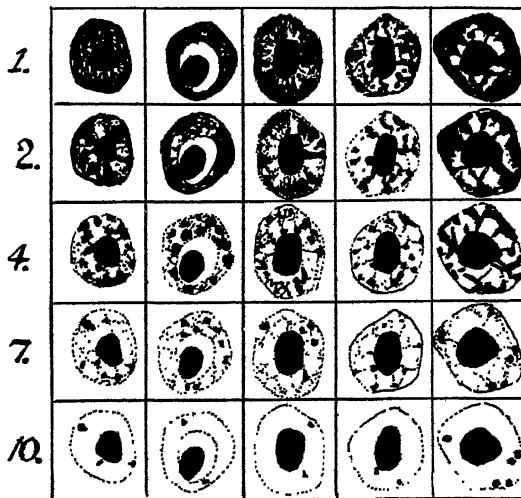
FIG. 5 shows drawings of optical sections of five normal nuclei stained with iron-hæmatoxy-lin and differentiated for varying lengths of time from 1 to 10 minutes. Note the progressive decolouration of the linin network and of the chromatin granules.

DISCUSSION.

The changes here described are early changes, and not to be confused with degenerative changes which occur later when the radiated cell is dying or dead, and which are common to cells dying of many causes. Such changes as pyknosis or vacuolation of the chromatin, etc. These are to be seen in tissues subjected to radiation and examined at any time after an interval of a few days.

The only paper which I have found dealing with early changes is the work of Ludford (1932). He exposed a number of different mouse tumours and examined them at intervals up to 22 days. Confining attention to the changes occurring within 3 days, he says as regards adenocarcinoma No. 27, 24 hours after radiation, " There is an increase in nuclear bulk without any corresponding increase of the chromatin granules. The linin network looks more distended."

The present findings, as has been seen, confirm these findings. After 3 days he describes an association of vacuoles with the chromatin granules, " As though the true chromatin has become transformed into an achromatinic substance." This was not observed in bean roots. Dealing with mammary carcinoma No. 63, 2 days after radiation, he says, " The nuclei are less chromatinic and have a clear appearance. There are scattered granules of chromatin, but there is little or no chromatin associated with the nucleoli." Ludford (1932), in speaking of " Chromatin associated with the nucleoli," refers to chromatin granules which sometimes occur around the periphery of the nucleolus. My observations confirm this, and are described at length in a previous paper (1933). Under Sarcoma No. 37, 45 hours after radiation, he says, " The nuclei show a tendency for the achromatinic substance to be increased in amount at the expense of the chromatin." I have not observed this change in bean roots which Ludford illustrates in figs. 25 and 26. It appears that some of the chromatin granules are converted, or partly converted, into a substance which does not stain by Feulgen's method. Ludford's observations are chiefly concerned with changes in mitochondria, Golgi apparatus, and vital staining reactions ; he does not pay great attention to changes in the non-dividing nucleus, nevertheless his observations and mine are for the most part in agreement.

CONCLUSIONS.

Two or three days after radiation the nuclei of cells are greatly increased in size, whether β or γ radiation be used, and in the cells of an Infusorian, of Jensen's rat sarcoma, and of the bean root.

This increase is due to a great increase in the nucleo-plasm, the other constituents of the nucleus remaining normal in amount. The chromatin becomes thus more dispersed and has the appearance of being diminished in amount, but in reality it remains normal in quantity. The nuclear membrane

is stretched, and the linin network comes to have wider meshes than normal. The nucleolus is increased in size.

The radium used was on loan from the Medical Research Council.

The expenses of this research were partly defrayed by the British Empire Cancer Campaign.

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535. 826. 3.   XIV.—AN IMPROVED METHOD OF ORIENTATING MINUTE
SPECIMENS FOR SECTION CUTTING.

By Douglas P. Wilson, M.Sc.

(Read May 17th, 1933.)

One Text-Figure.

Various methods have been described for the cutting of sections of minute
objects in definite planes, and of those tried Newth's second method (1919,
p. 548) most nearly approaches perfection. It forms the substantial basis
of the technique here described. The latter is, indeed, really a modification
in detail of this method of Newth's, but these modified details so increase
the efficiency of the process that it is felt they should be placed on record.
Workers nearly always experience difficulty the first time they attempt a
technique involving double embedding in collodion and paraffin wax, and it
is hoped that the full instructions here given will be of help to them. At the
best of times the method is admittedly uncertain and tricky, but by paying
throughout scrupulous attention to what at first sight may appear to be
unimportant details, the number of wasted slides will not be very large.

Embedding in Celloidin.

The collodion used is that supplied by Schering under the name of
" celloidin." A thick solution is made by dissolving in equal parts of absolute
alcohol and ether and to it an equal volume of clove oil is added and well
stirred in. The volatile constituents are then allowed to evaporate slowly
by standing in a warm place, stirring from time to time. When the smell
of ether has disappeared the solution will be found on cooling to be very
thick and must be thinned down by the addition of more clove oil. The final
consistency is gauged by experience, but it can be described as that of a syrup
which is a little less viscous than ordinary treacle. At 17° C. a lead shot
weighing 0·1 gm. takes 21 seconds to sink 1 cm. in it.

The specimens are embedded in this syrup as follows: They are first
thoroughly stained in a solution of eosin in absolute alcohol (or in borax
carmine should eosin prove unsuitable) so that they will be visible later on.
A small tube, supported upright in a cork, is partially filled with thick
celloidin, on top of which is placed first a thin solution of celloidin (made by
adding an equal volume of clove oil to a portion of the thick syrup) and then
a layer of clove oil. The specimens are pipetted up in their eosin alcohol

and run on to the surface of the clove oil. During the next few days they slowly sink into the thick celloidin syrup and the solutions above are removed.

ORIENTATING—FIRST STAGE.

A number of small cells have to be prepared similar to those described by Newth (1919, p. 548, text-fig. 3). Mine are made by sticking on wax-smeared slips of glass flat metal rings, $\frac{1}{2}$ inch external diameter, $\frac{3}{8}$ inch internal diameter, and $\frac{1}{16}$ inch high, dipped in molten wax. The cells are placed in small Petri dishes. A specimen is put into each together with sufficient celloidin solution to fill it to the brim. If too much solution is added a mounted needle passed over the top of the cell will remove the surplus.

After allowing a few minutes for the celloidin syrup to level up, the cell in its Petri dish is placed on the stage of the microscope. Through a low-power objective the position of the specimen is noted. Now the plane of section will—after subsequent operations—be vertical to the surface of the cell and so the specimen must be turned so that the plane in which it is to be sectioned is also vertical. To do this the celloidin is disturbed with a mounted needle in such a way as to cause the specimen to assume the desired position.

It has not been found necessary to keep the preparation on the stage of the microscope until the celloidin has set, as Newth advised. In practice, after each specimen has been orientated the preparation is carefully placed on the bench. After 10 or 15 minutes the specimens are examined and if any should have moved they are re-orientated and again left for a similar period and re-examined. When none has changed position during one of these periods the preparations are ready for hardening. This can be done by Newth's method of carefully pouring xylol into each dish until the cell is covered. This worked well for Polychæte larvæ with long spines, but with some very small specimens lacking such spines it completely failed, as they invariably rotated while the celloidin was hardening. It was found much more effective to harden in chloroform vapour, and that the best way to do this is to place the Petri dishes inside a large covered level-bottomed dish, together with a small beaker containing chloroform. They are left overnight (about 15 hours) and at ordinary room temperature (60°–65° F. or 15·5°–18·3° C.) will be well hardened by the next morning. Should the laboratory temperature fall belowt his at night, the vapour pressure of the chloroform will be insufficient to do its work and it will then be necessary to arrange some simple thermostatic method of keeping the temperature inside the dish about 65° F. (18·3° C.). The large dish can be placed inside a larger one containing water which is heated by an immersed electric light bulb. The latter is switched off by a thermostat whenever the temperature reaches 65° F. This has proved most successful. The celloidin hardens without causing the slightest displacement of the specimen. I have not yet had a single failure in this respect although I have experimented with several types and sizes of small organisms. By hardening in this way the final orientation

15—2

has become so accurate that it is possible to arrange to cut in any desired plane with the assured knowledge that the finished sections will not deviate from it more than two or three degrees. For most purposes such an error is negligible.

After the celloidin has been hardened by the chloroform the Petri dishes are filled with xylol. Besides completing any hardening that may still be necessary this dissolves the paraffin wax and so loosens the cells that in an hour or two the celloidin plates can be lifted out and dropped into cedar-wood oil, where they should remain for a few hours. This removes the xylol, whose presence would be inconvenient during the following operations.

<center>ORIENTATING—SECOND STAGE.</center>

We have by the above means succeeded in fixing at right angles to the surface of the celloidin plate the plane in which the specimen is to be cut. It remains to cut from the plate a bar in such a way that this same plane shall lie transversely to its length. The method adopted is again in principle that of Newth, but some of the details are different.

The celloidin plate is taken out of the cedar-wood oil and placed on a microscope slide clipped in the mechanical stage of a microscope. The specimen is focused with a low power. The eye-piece must contain a micrometer of the squared net type or one with cross-wires. The eye-piece is turned until the horizontal wire lies parallel to the horizontal movement of the mechanical stage. With fingers the celloidin plate is turned until the plane in which the specimen is to be cut coincides with the vertical wire. With the mechanical stage the specimen is brought up to the place where the wires cross. Using the horizontal movement only the slide is moved to one side, and by looking down the microscope a very small spot of ink is placed on one end of the slide under the place where the wires cross. The slide is then moved back the other way and a similar spot placed at the other end. The slide is very carefully, without tilting or jerking, removed from the stage and placed over a ruled line on a sheet of paper (fig. 1A). Both spots are brought on to this line. A really sharp safety-razor blade—of a one-edge variety—held firmly in the fingers of the right hand, is lowered slowly edge downwards on to the celloidin plate a little to one side of the line but parallel to it (dotted line in fig. 1A). As soon as it touches the plate the latter can be steadied with a left-hand finger and a clean cut made. This cut fixes the longitudinal axis of the desired bar.

Another cut is made parallel to the first, a short distance on the other side of the specimen (dotted line in fig. 1B). The latter is now contained in a bar of celloidin, often about the middle. It is convenient to cut off one end of the bar a little way in front of it (dotted line 3 in fig. 1C), and in order to indicate in which end of the shortened bar the specimen is situated a corner is removed from the opposite end (dotted line 4 in fig. 1C). This should be taken away from the side made by the second parallel cut as it is advisable
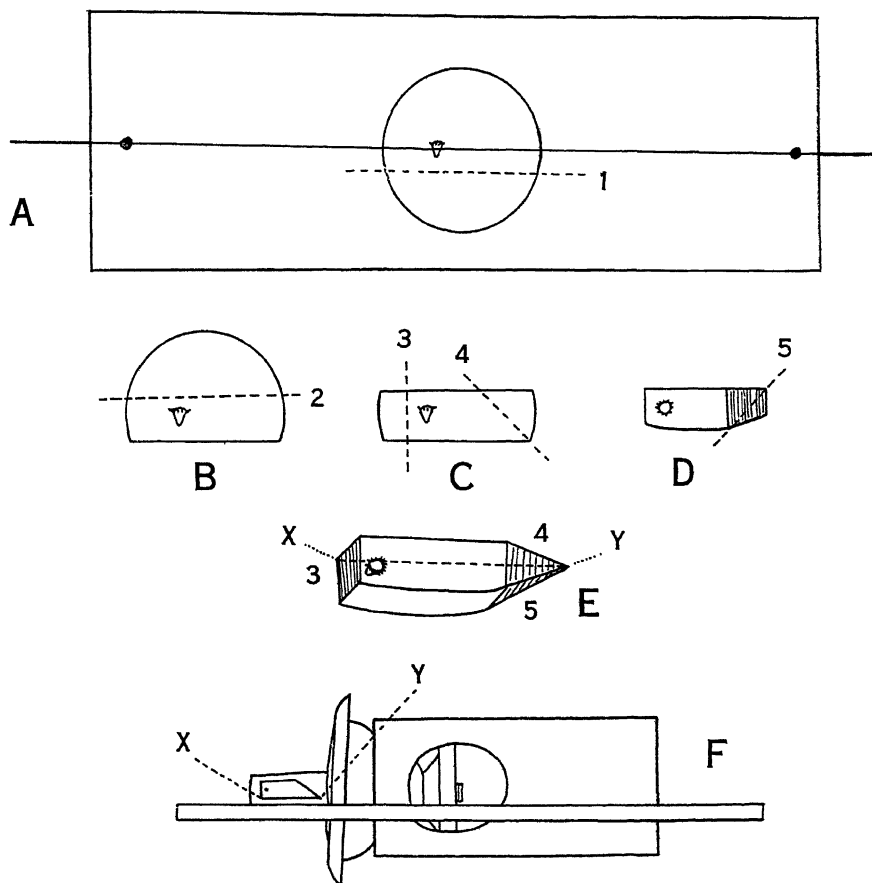
Fig. 1.

A.—Diagram of method of making the first cut (dotted line 1) across the celloidin plate. In this case the specimen—a trochosphere—is to be cut into sagittal sections. At either end of the microscope slide are seen the ink-spots placed in position over a ruled line.

B–D.—Stages in trimming the celloidin bar, the numbered dotted lines representing the successive cuts. At D the bar has been turned over onto the side formed by the first cut so that the side which was originally part of the upper convex surface of the plate is now the lower side of the figure. The shaded part is the surface formed by the fourth cut.

E shows, on a larger scale, a trimmed bar seen as a solid object. The shaded faces were formed by the cuts corresponding to the numbers beside them. The furthest edge XY is that between the side formed by the first cut and the side which was originally part of the lower surface of the celloidin plate.

F.—Diagram to illustrate method of orientating the wax block on an orientating block-holder. The edge XY is brought parallel to the longitudinal axis of the holder. This operation is performed for two planes at right angles to one another, the object-holder being rotated through 90° between the first and second adjustment of the movable end.

to leave the full length of the first cut to orientate the wax block by later on. The first cut is used for this purpose rather than the second as it is the more likely to be strictly at right angles to the intended plane of section.

One point requires attention. Up to now we have assumed that the upper and lower faces of the celloidin plate are flat and parallel; actually it will be found that only the lower face is plane, the upper being slightly convex. This convexity arose during hardening, but it is of no account if we mark the bar so that we can later distinguish between the upper and lower faces. Turn the trimmed bar over on its side and cut off a corner at the end away from the object and on the upper convex side (dotted line in fig. 1D. In the figure the upper convex side is lowermost).

Trimmed bars are stored in cedar-wood oil until it is convenient to embed them in wax.

EMBEDDING AND CUTTING IN PARAFFIN WAX.

A hard wax should be chosen. Surplus cedar-wood oil is gently wiped off the bars with filter-paper, and they are then passed through two baths of wax and are allowed to remain in each for about half an hour. They are embedded in glycerine-smeared watch-glasses, cooled in tepid water as advised elsewhere (Wilson, 1932, p. 237).

The wax blocks are trimmed for sectioning by a method described in another paper (Wilson, 1933), with the difference that an orientating block-holder is used instead of a plain one. The roughly cut wax block is stuck on to the block-holder as squarely as possible—with the pointed end of the contained celloidin bar downwards—and then either before or after trimming, but preferably before, adjustments are made so that the celloidin bar shall be cut exactly transversely. This is quite easy to do as the celloidin shows up distinctly in the wax and it is only necessary to make sure that the two sides of the bar (the original lower surface and the side of the first cut), which have already been marked out by the cut-off corners, are parallel to the axis of the cylindrical part of the holder. Actually one judges whether the edge where these two sides meet is thus parallel (edge XY in fig. 1E). A straight rod held along the side of the cylinder parallel to its axis (fig. 1F) forms an excellent guide while making the necessary adjustments to the movable end of the holder. It must, of course, be adjusted from two planes at right angles to one another.

The knife must be really sharp and the cutting movement as slow as possible consistent with proper ribboning of the sections. In general, the slower the cut is made the less the celloidin is wrinkled, a fast motion invariably causes it to crinkle badly. The temperature of the room while sectioning is important. In my experience 60° F. (15·5° C.) or thereabouts is best. At temperatures not very much lower (55° F. and below) the sections will not ribbon well, while at higher temperatures (65° F. and above) the

wax becomes too soft, compressing easily and thereby causing the celloidin sections to wrinkle badly.

Mounting the Sections.

The best method of mounting is to mix one or two drops of Meyer's albumen with a watch-glass full of distilled water. A little of this liquid is placed on the slide and the sections are lowered on to its surface with great care to avoid trapping air bubbles. The ribbon is then stretched by heat as usual, but the temperature must be controlled accurately. My slides are placed on a flat part of the embedding oven where the temperature is just below the melting-point of the wax (actually 55° C. is registered by a thermometer with the bulb placed on this spot), and to ensure quick conduction of heat into the slide a drop of water is placed between it and the metal. After a minute or so here, when no more lengthening of the ribbon occurs, the slide is removed to another part of the oven-top where a thermometer registers 40° C. A higher temperature (45°–50° C.) would probably be better, but I have not had facilities to try it. A finger-bowl is inverted over the slide and a fairly large lump of cotton-wool well soaked in ether is placed under the bowl by its side. The surplus albumen liquid is mopped up by a piece of filter-paper pushed under the edge of the bowl. Everything is left as it is for at least an hour. Drying should take place slowly or the celloidin sections may crinkle. After an hour or two the inside of the bowl may be wiped free from condensed moisture and any water under the slide wiped away. Drying should be continued for at least 24 hours before the sections are stained, otherwise they may come off the slide.

The ether is used, of course, to soften the celloidin and thereby increase the chances of the sections drying really flat. A mixture of equal parts of ether and absolute alcohol gives perhaps slightly better results than ether alone. The difficulty of flattening celloidin sections is the weak part of this method of orientation. One can never be sure that any particular set of sections will flatten to perfection, and one should be prepared to lose a small percentage of them. Unless there is an extreme shortage of material this is not usually a serious matter, for the majority of the series will be unspoilt.

After thorough drying the slides are treated for staining in the usual way. The celloidin does not interfere with the staining, and after mounting in Canada balsam it becomes for all practical purposes invisible. It forms a firm matrix supporting the tissues and holding isolated fragments in their proper positions. No attempt, therefore, should be made to dissolve it away as is sometimes done. Owing to the support it gives to the tissues it is possible to treat the slide when mounting in a way which would ruin ordinary paraffin wax sections. When the cover-glass has been lowered into position it is covered by a piece of filter-paper over which a finger is passed gently. This presses the cover-glass down very close to the sections, surplus balsam squeezing out all round. By doing this not only does the slide dry firm

enough for use more quickly than is usual, but the maximum possible room is ensured between the lens of an oil-immersion objective and the cover-glass, lowering the risk of breakage to a minimum.

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XV.—THE GOLGI APPARATUS OF PROTOZOA. 576.312.3.

By Joyce C. Hill, B.A. (Dubl.).

(Zoology Dept., Trinity College, Dublin.)

(*Communicated by Professor J. Brontë Gatenby.*)

Five Text-Figures.

Several attempts have recently been made to establish in Protozoa the homologies of the constant cell inclusions of the Metazoa. King (1927) published in this Journal a review of the Golgi apparatus in Protozoa, but as much work has been done on the subject since that time the present paper, while not neglecting earlier views, is an attempt to consider also the more recent work on the subject.

It was in the Sporozoa that the Golgi apparatus of the Protozoa was first described, and here alone do we find agreement as to the identity of the material under consideration with the metazoan Golgi material. In 1914 Hirschler showed in Monocystis ascidiæ a series of vesicles and crescents which bore a striking resemblance to the metazoan Golgi elements, in that they were differentiated into chromophile and chromophobe parts and were stained up by Mann Kopsch methods. Similar scale-like Golgi bodies were also found in other Gregarines : *Diplocystis phryganeæ, G. polymorpha, G. blattarum.* These early results of Hirschler were later confirmed by King and Gatenby, who in 1923 described the Golgi bodies of a Coccidian : *Adelea ovata.* These workers describe the Golgi apparatus in the forms studied by them as dissolved away by the same fluids, preserved by the same reagents, and stained by the same methods as the metazoan Golgi apparatus. This Golgi apparatus consists of separate dictyosomes or crescentic rods with the power of fission as in Metazoa. In schizonts and merozoites the Golgi apparatus always lies away from the nucleolus. During division of the schizont the Golgi elements are attracted into subequal groups of dictyosomes and granules round each nucleus, in a manner very similar to dictyokinesis in many Metazoan cell divisions. This is an important observation, and lends strong support to the view that these are Golgi elements. Hence it would seem that in Sporozoa the typical Golgi apparatus is already formed and established ; and is demonstrated by the usual methods of osmic and silver fixation. Joyet-Lavergne (1923) also obtained similar conclusions after working on *Adelina demidiata.*

Gatenby suggested that Golgi bodies probably arose in connection with

the terminal bead of the flagellum of some primitive flagellate. From its primitive position in the metazoan cell, always associated at some time with the centrosome centrosphere complex, he concludes that in the early history of the metazoan cell the Golgi apparatus and the centrosome were evolved side by side. As we shall see, this theory was later supported by much practical evidence put forward by Duboscq and Grassé.

The flagellates are by some workers considered as the most primitive group of the Protozoa. Hence the nature of the Golgi apparatus in this group was early recognized as being worthy of investigation, Duboscq and Grassé being among the first to aid in the elucidation of this problem. These authors advance strong evidence for the view that the parabasal apparatus of flagellates is the homologue of the Golgi apparatus of metazoan germ cells. Both parabasals and Golgi elements are usually destroyed or greatly altered by fixatives containing acetic acid. In the case of the Herpetomonads and Bodos the parabasal apparatus persists apparently unchanged after such fixation, but according to King (1927) this only shows that here the proportion of proteid to lipoid matter is higher than in other forms, similar differences of resistance being sometimes found among metazoan Golgi bodies. Like the Golgi apparatus of invertebrate germ cells, the parabasal is clearly demonstrable by hæmatoxylin, after osmication, by silver nitrate, Cajal, or by Mann Kopsch methods. In flagellates the parabasal has frequently the same chromophile-chromophobe structure as the Golgi apparatus of metazoan germ cells ; this has been shown by Duboscq and Grassé in Janckiella, Holomastigotes, Spirotrichonympha, Trichonympha, etc. King (1927) gives figures. Also the parabasal body, like the Golgi apparatus of many cells, is concerned in secretion ; Grassé states that in *Trichomonas batrachorum* and *Tetramastix bufonis* droplets break off from the chromophobe substance of the apparatus and pass into the cytoplasm. Hence there appears to be some identity between the parabasal body of flagellates and the Golgi apparatus of Metazoa and of the Sporozoa. There is also in some cases a close morphological resemblance between these two cell inclusions. In the case of the sporozoan Golgi apparatus, Duboscq and Grassé note the resemblance of the parabasal of Pseudotrichonympha to the Golgi apparatus of the schizozoites of *Aggregata eberthi* as described by Joyet-Lavergne. In the case of Aggregata the Golgi apparatus is in young schizozoites in the form of a crescent, connected with the centrosome by the siderophile axis. Later the crescent straightens out to form a rod, which then splits, half lying on each side of the axis. This stage shows a strong resemblance to the parabasal apparatus of Pseudotrichonympha, which consists of two parallel suspensory filaments leading from the blepharoplast towards the nucleus. Hence the rod-like type of parabasal so characteristic of the Polymastigina and Hypermastigina seems to have a parallel in the Golgi apparatus of some sporozoan and even of some metazoan cells. In certain cases the form of the parabasal strongly suggests the type of Golgi apparatus familiar in the gametogenesis of many metazoa.

It would be well at this stage to mention the main physico-chemical properties of the parabasal apparatus. The slow reduction of OsO_4 and the fact that the apparatus stains red with Sudan III points to the conclusion that it is of a lipoid nature. As in metazoan Golgi bodies, however, there is always present a greater or lesser proportion of proteid.

Intra-vitam staining seems to have presented some difficulty, but Grassé succeeded in certain cases by using 1/30,000 solution of Janus B. He did not succeed in getting neutral red to stain the parabasal.

In *Jœnia annectans*, Duboscq and Grassé (1928) particularly emphasize the secretory activity of the parabasal during division. Osmiophile vesicles, each composed of a cap of chromophile substance surrounding chromophobe material, are expelled into the cytoplasm. Chatton and Grassé (1929) carried out investigations on Polykrikos Schwartzi, a Dinoflagellate. They describe the presence in this form of oblong osmiophile vesicles reminiscent of those observed previously by Hirschler in numerous Protozoa, and called Golgi vesicles or crescents. These workers also figure three long streamer-like structures which are the parabasals. They state that the osmiophile vesicles seem quite independent of the parabasals, but are inclined to think that the vesicles are products of granules liberated by the parabasal, reminiscent of the secretion of very similar structures by the parabasal in Jœnia.

In connection with the Golgi apparatus of Sporozoa, we pointed out the remarkable resemblances which exist between the behaviour of these elements in Coccidians during division with the phenomena of dictyokinesis commonly observed in metazoan cells. Among the flagellates it is less easy to indicate such a resemblance in behaviour during division, yet with regard to the parabasal in division there are several points which are worthy of note. It will be remembered that the parabasal always itself divides at cell division (fig. 1 from E. B. Wilson). The parabasal is typically connected by fibrillæ with both blepharoplast and nucleus, in this respect showing resemblances to the idiozome of the metazoan cell, which is contiguous simultaneously with the nucleus and with the centrosome. In most flagellates the parabasal apparatus maintains its original position, the blepharoplast remaining contiguous when they divide. However, in Holomastigotes and Spirotrichonympha, the expansion of the blepharoplasts into long ciliated spirals involves the breaking up of the parabasal apparatus. It is noteworthy that among Vertebrates, Ludford has shown that in certain cases of cell division the Golgi apparatus is able to pull apart without the intervention of the centrosomes; thus in cells such as the adenocarcinoma of the mouse, where the Golgi apparatus occurs as scattered rodlets, its behaviour during mitosis is not directly influenced by the centrosomes. In the rapidly growing sarcoma the apparatus is drawn into two parts by the separating centrosomes. He observed certain cases of retarded scattering of the Golgi apparatus in an adenocarcinoma of the rat, and in a squamous cell carcinoma of the mouse. These cases, he says,

are not apparently associated with a pathological condition of the cells, but point to the attraction between the apparatus and the centrosome as not being fundamentally important in the mechanism of the cell. We conclude, therefore, that the conditions of division among the flagellates are similar to those of many cells of the metazoa, and we may therefore emphasize this resemblance to dictyokinesis exhibited by the parabasal in division.

Brown (1930) is against the parabasal homology. He carried out experiments on a Hypermastigote flagellate, Microjœnia, and states that in this

Fig. 1.

form there are Golgi bodies " similar to those described by Hirschler," which appear as rings, crescents, and spheres on treatment with osmic. He gives a figure showing the Golgi bodies and also the two parabasals (fig. 2). The latter he says " lie on each side of the nucleus, suspended from the base of the centroblepharoplast by small strands, . . . and act independently of the parabasals in every way." In the same paper he gives figures of Torquenympha from material fixed in Champy, Flemming-without-acetic, and Schaudinn's fluid (with very little acetic) ; all these show a ring of eight ovoid

parabasal bodies. The fact that the parabasals stain in Schaudinn, etc., must not be taken as proof that they are not the Golgi apparatus; the only conclusion we can draw from this fact is that the proteid component is dominant. Grassé has shown, as we mentioned previously, that during division the parabasal in certain forms secretes a number of vesicles resembling dictyosomes. It seems a possible explanation of Brown's observations that what he describes in Microjœnia as Golgi bodies are merely vesicles secreted by the parabasals. Certainly Brown's evidence that these elements are Golgi bodies seems quite inadequate. True, he shows that they are capable of osmic impregnation, and exhibit something of the morphological form frequently shown by Golgi bodies among metazoa. On the other hand, the structures are not shown to be argentophile, they have no special position with regard to the nucleus, nor are they demonstrated as exhibiting any behaviour during mitosis such as is seen among metazoan Golgi bodies.

A   B
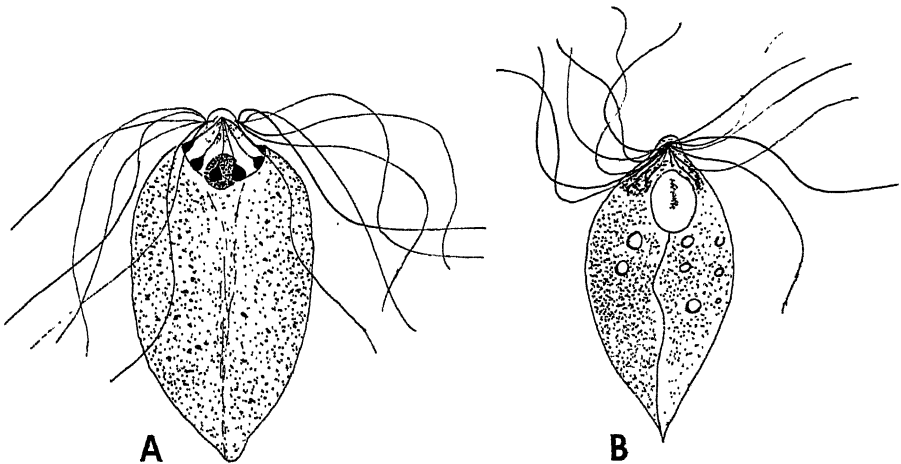
FIG. 2.

Hirschler (1932) has also shown some interest in this question of the parabasal body and its homologue in metazoan cells. He investigated three different flagellates : *Bodo lacertœ, Trypanoplasma helicis*, and *Lophomonas blattarum*, and came to the conclusion that the parabasal of Bodo represents the Golgi apparatus, that of Trypanoplasma represents the mitochondria, while with regard to the parabasal of Lophomonas he reaches no definite conclusion. He then compares the parabasal of Trypanoplasma representing the mitochondria, with the mitochondria of moth spermatid cells, but we find it extremely difficult to follow his attempted analogy between the highly specialized moth germ cells and the flagellates.

Grassé considers that the stigma of Euglenids corresponds to the parabasal of other flagellates, and hence to the Golgi apparatus of metazoa. He bases his suggestion on the fact that the stigma and the parabasal show similar reactions, being susceptible to acetic acid and being slowly impregnated by

osmium and silver. The stigma is described as consisting of a proteid (chromophobe) basis in which are scattered lipoid (chromophile) spherules. It seems to be closely related to the blepharoplast.

Brown has criticized Grassé's homologies concerned with the stigma of Euglenids. He states that the Golgi bodies of Euglena occur as spheres or demispheres with dark rims, and when imperfectly impregnated with osmic they stain up as rings or crescents. He quotes Mangenot (1926) as believing the stigma to be a modified chromoplast, and points out that chromoplasts are often sensitive to acetic acid, and will in rare cases darken to some extent with osmic acid ; when the available osmic is used by such structures the Golgi apparatus is imperfectly impregnated.

Brown considers that in attempting to recognize Golgi material in the Protozoa the following characteristics should be emphasized : (1) Consistent, not merely occasional, impregnation by osmic methods ; (2) Resistance to the usual methods of bleaching after osmication ; (3) Consistent impregnation by silver methods ; (4) Occurrence in Protozoa generally and not merely in certain species ; (5) General similarity of form in different Protozoa. Applying these criteria to certain examples of Golgi apparatus he finds the basis for their identification as Golgi material rather inadequate, i.e. he rules out the stigma of Euglenids and the parabasal apparatus of other flagellates. We have already dealt with his work on the parabasal apparatus ; with regard to the stigma, it certainly seems that the evidence against its representing the Golgi apparatus is complete. Nevertheless, we are not as yet sufficiently convinced that the elements which Brown states " stain up with osmic as rings or crescents " are Golgi bodies.

An early attempt to find a representative of the Golgi apparatus of ciliates was made by King and Gatenby (1926) ; these workers, using Champy osmium fixation, demonstrated osmiophile bodies in *Opalina ranarum,* which they presumed to be Golgi elements. Cilia were described as passing down into the endoplasm, where each connects with one of the Golgi elements ; the latter are pyriform bodies giving similar reactions to those of the parabasals. Hence there was suggested a homology between these lipoid cell constituents of Opalina and the parabasals of flagellates already considered by Grassé to be of a Golgi nature. King also in 1926 reports scattered Golgi bodies in *Anoplophrya brasili,* a parasitic form in the gut of Cirratulus. These were revealed by iron hæmatoxylin staining after Champy fixation, consisting of pyriform bodies with a distinct differentiation into chromophile and chromophobe parts.

We come now to the work of Nassonow on the contractile vacuole of ciliates and flagellates, and, indeed, to a most interesting hypothesis with regard to the supposed Golgi apparatus in these groups.

Nassonow finds that the contractile vacuole is surrounded by a lipoid membrane. He first examined many Infusoria provided with a pulsating vacuole, and found in them all a lipoid organ which secreted and concentrated in its interior water and substances destined for removal. In some forms,

e.g. *Lionotus folium,* the excretory apparatus occurs as a lipoid mass of plasma. In others, e.g. in infusorian, Peritricha, there is a lipoid sac with permanent thick walls. He describes a highly complex structure in Paramœcium which has a permanent excretory apparatus with a lipoid membrane. The apparatus consists of a thin-walled reservoir and afferent canals with three parts, an intercalary piece, the ampulla, and the terminal section.

It is this lipoid organ that Nassanow homologizes with the Golgi apparatus of metazoan cells. His hypothesis rests firstly on the similarity of chemical reactions of the two organs, both being lipoidal and showing reduction of OsO_4. Secondly, there is great similarity of morphological structure shown by comparison of their primitive forms. In Protozoa the most primitive type of excretory apparatus is a vesicle with lipoid walls. Among the Metazoa, according to Nassanow, the Golgi apparatus often has a similar form, particularly well shown in Sponge choanocytes and many germ cells which have a simple vesicular type of Golgi apparatus. The third piece of evidence which he brings forward is similarity of function ; according to Nassanow the relation of the lipoid membrane to excretion is similar to the relation of the metazoan Golgi apparatus to excretion. Nassonow distinguishes two phases in secretion by the metazoan Golgi apparatus :

1. The " bound secretion " phase, during which the water and other substances destined for removal are imprisoned in the interior of the Golgi material. The lipoidal substance of the apparatus acts as a semi-permeable membrane and ensures the selective penetration of substances to the forming secretion.

2. The phase of " free secretion," during which the secretion is released into the cytoplasm, where it may remain for some time in the form of granules or drops. According as it is necessary the free secretion is ejected from the cell.

The excretory apparatus of Protozoa Nassanow describes as working in the following way : firstly, it accumulates the water and other substances destined for excretion which form the " pulsating vacuole." Here also the lipoid substance of the apparatus acts as a semi-permeable membrane with its contents of higher osmotic pressure than the surrounding cytoplasm. Fluid therefore flows into the vacuole till it is completely distended, after which the pressure causes the membrane to burst and set free the fluid. Immediately, however, the membrane repairs itself, owing to its viscous consistency, but in order to induce a fresh inflow of fluid into the vacuole, a new supply of osmotically active substances is required. Nassonow noticed small vacuoles forming after systole in the osmiophile membrane of Campanella ; later these break into the central vacuole. His idea, therefore, was that the osmiophile membrane secreted the osmotically active substance necessary to the working of the vacuole, and poured it into the latter after each systole.

In his earlier work on the excretion of Protozoa the stage of the free secretion is represented only by the watery substance which has been shot

out of the body. In his second paper (25) Nassonow investigates the excretory apparatus of certain infusoria which seems to show a much closer resemblance to the metazoan apparatus ; for it is possible to establish during its activity two phases, which Nassonow considers correspond to the phase of secretion established by him in the gland cells. The water and the substances dissolved in it occur in the form of collecting vacuoles in the interior of the lipoid mass of the ring ; this stage he compares with the stage of the " Bound secretion." As the little vacuoles flow together they get into the centre of the ring, where they form the real pulsating vacuole which lies free in the plasma, without being surrounded by the substance of the apparatus. This phase Nassonow regards as corresponding to the phase of " free secretion " in the gland cells of the Metazoa. The ring and cup-shaped configuration displayed in Chilodon and Dogielella is, indeed, strongly reminiscent of the ring-like form of the Golgi apparatus in many Metazoan cells, as will be seen in figures given by King (27).

We see, therefore, that Nassonow's hypothesis was put forward after much careful work, and it certainly has many commendable features which resulted in its almost universal acceptance when it was first advanced. To-day, however, it is not accepted *in toto*, and we must now consider some of the objections to it raised by modern workers.

While the " bound secretion " hypothesis of Nassanow is not now considered to be entirely wrong, it has been shown that it does not cover all the facts. Hirsch and Duthie * have demonstrated that the process of secretion in pancreas cells takes place as follows :

Prozymogen granules originating at the periphery of the cell, generally in connection with mitochondria, gradually move inwards to the region of the Golgi apparatus. At first the granules stain neutral red and Janus green, but later do not take up these dyes. The granules probably become embedded in the Golgi apparatus, and later move out into the zymogen zone.

Other criticisms of Nassonow's hypothesis come from several more recent workers, who declare that stricter criteria are now essential when attempting to homologize metazoan with protozoan cell inclusions.

With regard to the Golgi apparatus of Protozoa, although Nassonow succeeded in demonstrating a rim round the vacuole which blackened with osmic acid, he did not investigate the question of the silver impregnation of this structure. Brown points out that it is important that homologous organs be of universal appearance in all protozoa, not merely in certain forms. Nassonow found a lipoid cortex around the contractile vacuole in many forms, among ciliates and flagellates, but more recent workers have shown that this condition is not universal among protozoa.

Miss I. Moore, after careful observations on *Blepharisma undulans*, found the lipoid cortex completely lacking in this form. V. E. Brown, working on *Amœba proteus*, showed that the contractile vacuole is not blackened

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* In press, Proc. Roy. Soc., London.

by osmic acid. He found in Amœba what seems to be a Golgi apparatus of the typical protozoan type, consisting of globules and spherules with clear centres and dark rims ; these stain with osmic acid (fig. 3).

In the absence of further evidence we cannot definitely claim these as Golgi bodies. On the whole, these facts seem to provide evidence against Nassonow's hypothesis as being universally true.

Hall also is against this, basing his objections on personal observations : he found that the contractile vacuole of Stylonychia did not show unquestionable osmic acid impregnation. In material impregnated by silver methods the contractile vacuole did not blacken at all. Using Kolatchew osmic, Da Fano silver, and Cajal silver methods, he found in several of his preparations that the contractile vacuole of Vorticella remained unblackened, similar results being obtained in silver preparations of *Paramœcium caudatum*,
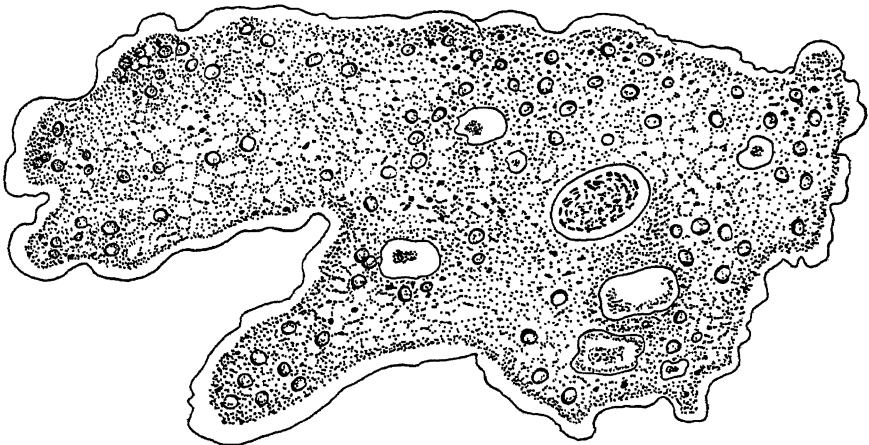
Fig. 3.

which again showed no blackening of the contractile vacuole. Since Paramœcium and Vorticella are two of the ciliates investigated by Nassonow, we must conclude that unless Hall's technique was faulty, we have here additional objections to recognizing the contractile vacuole of ciliates as always corresponding to the Golgi apparatus of the Metazoa. We must note, however, that occasional failure to obtain blackening cannot be taken as definite proof of absence of Golgi material.

The result of these criticisms therefore seem not completely to disprove Nassonow's hypothesis, but only to reveal the fact that in certain cases the contractile vacuole has no lipoid cortex, in which case the Golgi apparatus, if present, is represented by some other element. The presence of the remarkable ring-like form of lipoid organ discovered by Nassonow in Chilodon and Dogielella has never been disputed. It is quite possible that we have two different forms of Golgi apparatus with which to deal.

In the parietal cells of the salivary glands of a grasshopper, Beams and

King have described a branching system of intracellular canaliculi opening to the surface of the cells by an efferent ductule. They state that "the intracellular canaliculi with their associated limiting osmiophilic membranes are directly comparable both from a morphological and physiological point of view to the contractile vacuole and associated membrane of certain ciliates as described by Nassonow. However, besides the osmiophilic limiting membrane (Golgi apparatus of Nassonow), they observed in the parietal cells typical insect Golgi bodies evenly distributed through the cell. Hence they conclude that the lipoid membrane surrounding the contractile vacuole of Protozoa does not represent the classical Golgi apparatus.

Hall is a strong supporter of the view that yet another protozoan cell inclusion is the homologue of the metazoan Golgi apparatus. This is the "vacuome" which, he says, "after *intra-vitam* staining with neutral red, impregnates with osmic or silver." Earlier observations by Grassé (1925) and by Joyet-Lavergne (1926) were considered to have shown that certain cytoplasmic inclusions ("vacuome") of Protozoa may be stained vitally with neutral red and impregnated by silver and osmic, and later workers, Cowdry and Scott, Chatton and Grassé, Levoff and Levoff, Volkonsky, etc., have demonstrated similar neutral red stainable inclusions. Hall has carried out considerable investigations on these lines, and bases much of his evidence on the universality of appearance of this "vacuome" in the Protozoa. One of his chief objections to recognizing other elements, e.g. the stigma, as the representative of the Golgi apparatus, is the fact that such occur merely in certain species and not in Protozoa generally. He certainly gives a very representative list of Protozoa in which he declares that this "vacuome" has been demonstrated : Chrysomonadida (Hall, 1930), Cryptomonadida (Hall, 1930), Dinoflagellida (Chatton and Grassé, 1929), Euglenida (Grassé, 1925 ; Hall, 1929, 1930), Phytomonadida (Hall and Nigrelli, 1931), Protomastigida (Hirschler, 1927 ; Levoff and Levoff, 1929 ; Nigrelli, 1929), Hypermastigina (Hirschler, 1927) ; among Sarcodina in the Amœbida (Hall, 1930) and Testacea (Hall and Loefer, 1930 ; Nigrelli and Hall, 1930) ; among Sporozoa, in the Gregarinida (Joyet-Lavergne, 1926) and Hæmosporidia (Cowdry and Scott, 1928) ; among Infusoria, in the Holotrichida (Dunihue, 1930 ; Volkonsky, 1929) and Peritrichida (Volkonsky, 1929) ; in the Hypertrichida, Stylonychia (Hall, 1931).

Hall writes : "In neutral red preparations of Euglena small globules were stained in five to ten minutes. . . . In material stained vitally with neutral red and then exposed to osmic vapour in hanging drop preparations the neutral red colour of the small globules gradually faded and had almost disappeared after several hours, when the globules became light grey in colour. . . . By the end of 24–36 hours the neutral red globules were usually dark grey, and the colour had deepened to a definite black after 4 or 5 days " (fig. 4).

In material impregnated by the Kolatchew method and bleached in turpentine small globules in the alveolar zone are definitely blackened.

These blackened inclusions correspond in size and distribution to the globules stained vitally with neutral red. In Euglypha the inclusions are described as visible in the living organism, stainable *intra vitam* with neutral red and impregnated by osmic or silver methods without previous treatment with vital dyes. Further, Hall states that material has been stained vitally with neutral red and then blackened with osmic under direct observation in sealed slide preparations, and that the neutral red stained inclusions are gradually impregnated by this method. Hence he considers that he has eliminated the possibility of these osmiophilic inclusions of Euglypha being artefacts, or of their appearance being induced by the action of vital dyes.

Although Hall's arguments may appear plausible and his results convincing, they have been criticized, and there exists a very strong opposition party which maintains that the "vacuome" must on no account be held
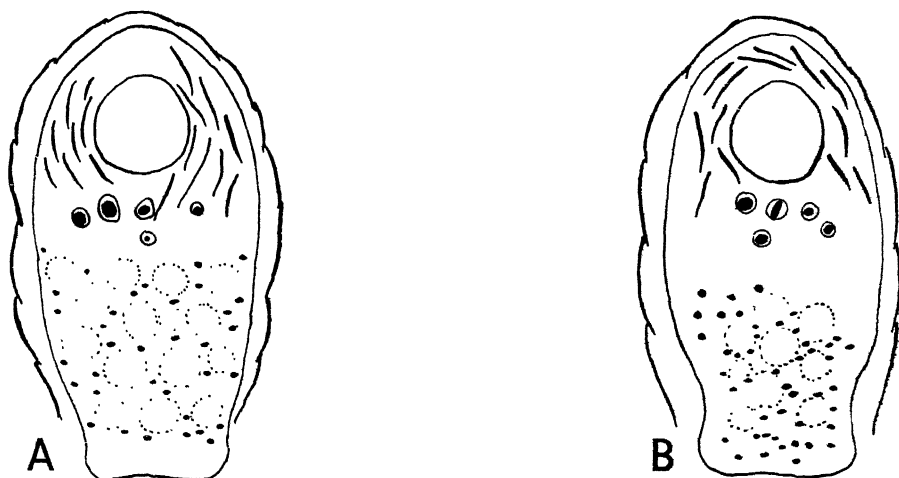
Fig. 4.

as the homologue of the Golgi material. The validity of Hall's technique is also considered somewhat questionable, as we shall see later. As early as 1926 Joyet-Lavergne studied the action of neutral red staining on three species of gregarines : *Gregarina crineata, G. polymorpha,* and *Steinina ovalis.* He states that the inclusions which take up neutral red are identifiable by their form and size with the Golgi elements. It was this discovery which was seized upon by so many of the later workers. However, even Joyet-Lavergne admits that the staining does not remain for long in these elements, and that it is difficult to establish the exact distribution of the elements stained with neutral red, as the colour diffuses through the cytoplasm.

Odette Tuzet has made some careful studies on the results of neutral red and janus green *intra-vitam* staining of *Gonospora Duboscqui.* Staining with janus green showed small green granules in the cytoplasm, which she asserts are mitochondria, being similar to those found in fixed preparations. Using

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neutral red, granules were obtained varying in number with the size of the gregarine. Next, preparations were made after Grassé's method—small black granules being revealed scattered through the cytoplasm, corresponding to those shown up by janus green and being the mitochondria. Among the mitochondria are found Golgi bodies of typical sporozoan type as described by Hirschler for Monocystis—consisting of circular discs showing division to chromophile and chromophobe parts. Tuzet states definitely that the bodies which take up neutral red are more numerous and also of smaller size than the Golgi bodies ; their images are not superposable. In Gonospora, therefore, Tuzet has demonstrated three distinct categories of cytoplasmic inclusions :

1. Vacuoles stainable with neutral red.
2. Mitochondria stainable with janus green.
3. Golgi bodies which are not revealed by either neutral red or janus green.

This work is therefore of the utmost importance as providing evidence against the identity of the Golgi apparatus with neutral red staining elements.
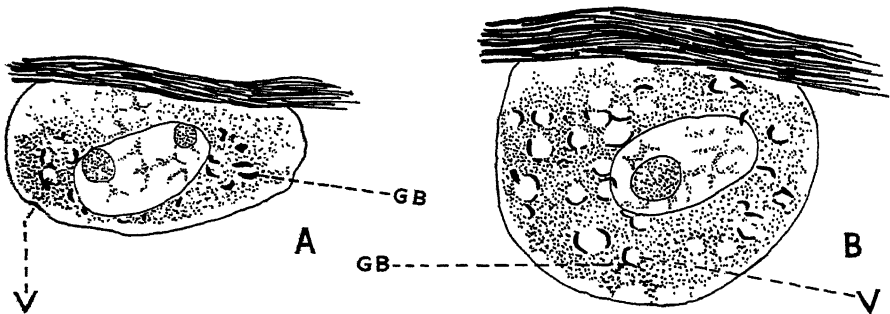
Fig. 5.

That secretion of the cytoplasm appears in close connection with Golgi elements has been known for many years, since the work of Gatenby and Ludford (1921) on the formation of yolk in the eggs of molluses. In addition, Ludford (1925) describes the secretory process in sebaceous gland cells, where the fatty secretion appears in the form of granules in intimate relationship with the Golgi apparatus, in an almost identical manner to the yolk of certain molluscan oocytes. During early stages of secretion the Golgi bodies proliferate, and certain of them are applied to the surface of vacuoles ; the vacuoles he considers as the first indications of secretion. The appearance at this stage is shown in fig. 5, the clear vacuole being surrounded by curved Golgi elements. The material of the vacuoles undergoes a chemical change resulting in the formation of fat, so that the vacuoles in the osmic impregnated material exhibit a progressive blackening as secretion proceeds. This blackening can be removed by treating sections with turpentine. It seems therefore that we have here an explanation of statements that inclusions

which take up neutral red are identifiable by their form and size with the Golgi elements. What Joyet-Lavergne, and also Hall and others, succeeded in staining with neutral red was probably the vesicle, not the enclosing dictyosome.

Several other workers are opposed to the view that there are structures in the cell which are coloured by neutral red and subsequently blackened by osmic acid which represent the Golgi material. Ludford has demonstrated that bodies coloured by trypan blue will turn black upon the application of osmic acid. More recently Beams and Krjukowa have found the same to be true for neutral red bodies. In all cases the bodies stained by trypan blue and neutral red have been shown to be distinct from the Golgi apparatus. Accordingly, it must on no account be thought that all bodies which stain *intra vitam* with vital dyes and subsequently blacken by osmic acid are of necessity the Golgi material. A very important point must be mentioned here : the neutral red staining and subsequent blackening by osmic acid of certain bodies is usually due to direct chemical action of osmic acid upon the preformed contents of the vacuole.

The " vacuome hypothesis " of Parat must be briefly dealt with here, for though not actually concerned with the Protozoa, several interesting points arise in connection with it.

In 1924 Parat and Painlevé, after investigations on Chironomus salivary gland cells, claimed that animal cells, like those of plants, contained only two types of cytoplasmic inclusions : the vacuome and the chondriome. The vacuome stains specifically in neutral red *intra vitam*, and consists of isolated vacuoles or else of a canalicular system. They claim that the classical Golgi apparatus is but an artefact produced by precipitation of silver or osmium at the surface of, inside, or between the vacuoles. In the salivary gland cells of Chironomus they contend that there exist only neutral red staining vacuome and numerous rod-shaped mitochondria. It is stated that the formalin cobalt nitrate technique of Da Fano and the Kopsch OsO_4 method impregnated bodies corresponding to the neutral red staining vacuome. Further, they claim that these neutral red vacuoles would, under certain circumstances, run together to form a net, considered by Parat as the inner reticulum of Golgi.

Subsequent investigations by Krjukowa, Beams, and Goldsmith, and by Gatenby demonstrated the presence in Chironomus salivary cells of normal Golgi bodies.

While Krjukowa showed the presence of the classical Golgi material in the salivary glands of Chironomus larvæ, he could not demonstrate the Golgi bodies after vital treatment by neutral red. His idea was that the neutral red stained only new formations in the cell, of the nature of secretory products. He was of the opinion that the neutral red bodies (secretory inclusions) were synthesized by the Golgi bodies—a view supporting the theory of Nassonow. Beams also noticed a close topographical relationship in some cases between the Golgi apparatus and the neutral red bodies in the pancreas. This Part

of the work is noteworthy in several respects as showing the presence of the typical Golgi apparatus in these forms, and contradicting the view of its identity with neutral red staining inclusions ; but, as we have previously shown, the synthesis of neutral red granules by the Golgi apparatus is not observed in pancreas cells, but rather they move in from the periphery of the cell towards the Golgi apparatus. A full account of the secretion process would be completely outside the bounds of this paper.

Gatenby, besides establishing the existence in Chironomus of normal Golgi bodies and mitochondria, obtained some interesting results using neutral red Ringer solutions on living salivary cells. These investigations on the neutral red cytology are particularly significant in connection with results obtained by Hall with which we dealt previously. Gatenby finds that the dye first completely diffuses through the cytoplasm, but within 15 minutes is in process of segregation into globules. When osmic acid solution or some such coagulant is run into the preparation, these globules are seen to be watery spaces filled with a heavy concentration, of neutral red. Hence the result of exposing these cells to neutral red solutions is the production in the cytoplasm of segregation spaces containing the dye. Gatenby is definitely against the idea of the universal existence of a vacuome stainable by neutral red, but states that neutral red stains supra- and intra-vitally a number of possibly unrelated but normally present granules, and in such cells as those of chironomus salivary gland produces by its poisonous effect segregation globules. In using the word vacuome as applied to the red globules appearing in some cells immersed in neutral red Ringer he considers that a cell inclusion is not signified, but rather the faculty of the cell to segregate dye into droplets.

Patten (1932), working on Opalina, used Hall's technique, but obtained contradictory results. In this form she could find staining of the endoplasmic bodies alone, so that there seems to be here an exception to Hall's lengthy list of forms in which a " vacuome " is present. Patten states that both Hall's alcoholic neutral red and Ringer neutral-red preparations were held over osmic vapour and the subsequent action watched ; the result was that the bodies rapidly became undistinguishable from the cytoplasm, losing pro- gressively more and more of their red colouring, so that they finally appeared again as clear spaces—no blackening was seen even after 2 days. Hence this is another point showing that care must be taken before we accept the validity of Hall's vacuoles.

We must now consider the results of some modern workers on the cyto- plasmic inclusions of certain ciliates.

Horning is sceptical concerning the findings of earlier investigators, who he says, " using somewhat capricious techniques, have described some of the specialized cytomicrosomes found only in Protozoa as representing true Golgi elements." He considers the mitochondria to have been neglected in the past, and thinks that workers before using techniques specific for the Golgi apparatus should study the mitochondrial components. He is opposed

to the comparisons drawn by several workers (King and Gatenby, and Duboscq and Grassé) between the structures designated by them as Golgi material in Protozoa and the ciliary flagellar apparatus, which mistake he puts down to their failure to distinguish the mitochondria from the remaining cell inclusions.

Among the ciliates, Richardson and Horning claim to have demonstrated in Protopalina the presence of three types of cell inclusions, considered to represent mitochondria together with associated synthesized vegetative granules and Golgi bodies. The vegetative granules are revealed in chrome osmium preparations stained by Heidenhain's iron alum hæmatoxylin as faintly staining, coarse granules, scattered at random in the cytoplasm. In shape they are pyriform, spheroid, or quite irregular. *Intra-vitam* staining with Janus green failed to stain these bodies. The mitochondria are short, deeply staining rods, with a precise longitudinal orientation, which very frequently exhibit a close relationship with the vegative granules. Occasionally Y- and V-shaped forms are seen, suggesting the incomplete longitudinal fission of mitochondria. The Golgi material, according to Horning, consists of irregularly twisted rods and granules scattered in the cytoplasm, but with a distinct morphology reaction to techniques when compared with the mitochondria. These Golgi bodies are revealed in Opalina treated with Da Fano's and Cajal's silver nitrate methods.

Horning rejects Gatenby's suggestion of the identity with the Golgi apparatus of the osmiophile pyriform bodies described by him in the endoplasm of Opalina, and regards them as identical with his vegetative grains.

Though Horning claims to have shown the presence of three distinct cytoplasmic inclusions—Golgi bodies, mitochondria, and vegetative granules—in Opalinids, there has been some confusion with regard to the endoplasmic bodies. Metcalf demonstrated two categories of cytoplasmic granules apart from the nuclei : (1) Ectoplasmic spherules within alveoli, (2) endosarc spherules, which are disc-shaped, elongated, or irregular in form, usually lying in a regular direction in the whole body, the flat side of the disc being parallel to the flattened surface of the body, so that in sections parallel to the flattened surface of the body, one sees them almost circular, while in others they appear almost rod-shaped. It seems probable that Metcalf's endoplasmic spherules correspond to Richardson and Horning's mitochondria and vegetative granules.

Patten has recently published a paper with the object of clearing up some of the confusion concerning the cytoplasmic inclusions of ciliates. In preparations fixed by the chrome-osmium method, Flemming without acetic, and stained with Heidenhain's iron alum hæmatoxylin and by Altmann's fixation stained Altmann's acid fuchsin and picric acid, this author demonstrates a large number of endoplasmic bodies, varying in shape, size, and general appearance. As opposed to Horning, who, as we have shown, considered the presence of two types of bodies in such preparations, e.g.

(*a*) vegetative granules which are irregular faintly staining bodies, and (*b*) the mitochondria which are rod-shaped or dumb-bell shaped, Patten considers that there is in *Opalina ranarum* but one class of body. The evidence for this opinion is based on the following facts :—

1. Irregular or rounded and rod-shaped bodies are generally found in different specimens of Opalina cut at different angles to the flattened surface of the organism, and where both forms are noted in the same individual they are most frequently found at different parts of the specimen, suggesting that at one end it had been cut parallel and at the other more transversely to the axis, transition stages occurring in the intermediate region.

2. The rod and dumb-bell forms (Horning's mitochondria) as well as the irregular forms are shown by alcoholic fixatives which normally dissolve the mitochondria. In one instance sections fixed by Da Fano's method were stained after toning with gold chloride with Altmann's acid fuchsin and picric acid, and similar rods and irregular structures were seen.

Hence Patten concludes that both rod-like and irregular bodies are but two aspects of the same body. She refers to figures in Richardson and Horning's paper which show the presence of a darkly staining cortex in the irregular bodies, and considers that this is probably seen in a different focus as a rod-shaped body. Richardson and Horning's observation that frequently these dark staining rods are attached to the lighter granules is interpreted by Patten as being actually the darker cortex of a lightly coloured disc.

She provides additional evidence from living material to show that these endoplasmic structures are all of one variety.

The question of the nature of these endoplasmic bodies is also dealt with ; Richardson and Horning homologized their vegetative granules with Gatenby's osmiophile bodies, but demonstrated another cell inclusion as representing the Golgi bodies ; Patten also is opposed to the idea that these endoplasmic structures in Opalina are true Golgi elements, basing her opinion on the grounds of microchemical dissimilarity, for these bodies are well fixed by methods which are known to dissolve the Golgi apparatus of other organisms. With regard to King and Gatenby's lipoid pyriform bodies, she is convinced that these bodies are identical with her own endoplasmic bodies ; the fibrils which are described by these authors as passing in from the cilia to the endoplasmic bodies are considered by her as corresponding to structures described by Konsuloff as the network of fibrils which assist in retaining the shape of the organism. Connection between the fibrils and the endoplasmic bodies themselves is denied.

The fact that these bodies stain *intra vitam* with janus green is brought forward as evidence that these are Golgi bodies, though acknowledgement is made of the fact that in certain cases insect Golgi elements do take up janus green. It is unlikely that they are mitochondria, since they are fixed by alcoholic methods. The appearance of these bodies is also against the view that they are mitochondria, since they are larger and more irregular than is usually found. Patten finally demonstrates the presence of other smaller

bodies, stainable *intra vitam* with janus green and showing a close resemblance to Metazoan mitochondria and to those of other Protozoa ; such bodies are never seen in preparations made by acetic or alcoholic fixatives, and may safely be regarded as representing the mitochondria.

Having rejected the notion that these endoplasmic bodies may represent the Golgi apparatus, Patten seeks to find some other representative of the Golgi bodies in Opalina. Using Da Fano's and Cajal's techniques, the Opalinids were shown to contain large densely blackened bodies frequently rather irregular in outline. This worker notes the similarity of these structures to the bodies in the outer regions of Protopalina as shown in the silver nitrate preparations of Richardson and Horning, but she fails to find their " twisted snake-like elements." After fixing by Nassonow's, Kolatchew's, and Mann-Kopsch methods, Patten failed to find any bodies like those shown in silver preparations. This fact, together with the dissimilarity of these bodies with the Golgi apparatus of other organisms, supports the idea that these blackened granules are not Golgi bodies at all, but are probably only artefacts. This view leaves us without a homologue of the Golgi apparatus in Opalina, and hence we reach a rather unsatisfactory conclusion.

Patten has, however, an explanation for the apparent absence of the Golgi apparatus in Opalina. With regard to Grassé's parabasal hypothesis, Patten considers that there is a close resemblance between the parabasal bodies of flagellates and the endoplasmic bodies of Opalina. The latter certainly persist after treatment with acetic acid, but, as we have seen, this is true also in certain cases for the parabasals, e.g. Herpetomonads and Bodos. The division into a darker cortex and more lightly staining medulla is often seen in the endoplasmic bodies. Against this homology of the parabasals and the endoplasmic bodies we must mention the reaction to vital stains. Grassé, as we noted previously, found great difficulty in this, only occasionally succeeding in staining the parabasal apparatus with janus green and never with neutral red. Patten finds in Opalina that the endoplasmic bodies stain, though somewhat capriciously, with janus green and quite regularly with neutral red. She suggests, therefore, that these endoplasmic bodies are secretory organs possessing much the same nature as the parabasal bodies of flagellates, and with these latter probably representing some primitive, undifferentiated form of Golgi apparatus.

The cytoplasmic inclusions of Nyctotherus have also excited considerable interest among recent workers. Horning describes the presence of mitochondria and Golgi bodies. He figures the mitochondria as groups of bodies, often rod-like, sometimes spherical or dumb-bell shaped. The Golgi bodies are described as clearly differentiated rod-like bodies or twisted filaments of larger dimensions than the mitochondria. They appear scattered irregularly through the cytoplasm, being revealed by Da Fano and Cajal methods.

A further investigation of these results by Patten brings out some interesting points. In Da Fano preparations this author finds bodies corresponding in structure with those identified by Horning and Richardson as Golgi bodies.

Preparations of Nyctotherus made by Flemming without acetic, Zenker's fluid, corrosive sublimate, acetic, absolute alcohol, and Carnoy's fluid stained with Heidenhain's iron alum hæmatoxylin show similar bodies. Patten states, however, that in some of her slides organisms could be found in which these bodies are absent. She declares that they may, indeed, be absent or few in number, but emphasizes the fact that failure to stain them is generally due to bad differentiation of the hæmatoxylin. Over-differentiation renders these bodies invisible, even when other cell elements are still quite clear. Under-differentiation is equally unsatisfactory, for then these bodies are masked owing to the presence of many other small bodies. The fact that Horning failed entirely to discover these bodies after fixation with absolute alcohol and staining with Heidenhain's hæmatoxylin was due undoubtedly to faulty differentiation. Since these bodies are revealed after staining with hæmatoxylin following fixation by alcohol or other lipoid dissolving substances, strong evidence is provided against their consisting of Golgi material. Patten therefore believes that they are bacteria, being influenced in this decision by the observation that using Gram's method for bacteria, the bodies under consideration gave a definite positive reaction. In Nyctotherus, again, therefore Patten has failed to demonstrate the presence of any cell inclusion corresponding to the Golgi apparatus. She recognizes the fact that in Kolatchev material the absence of these bodies may be due to insufficient post-osmication, and also admits that their presence may be veiled by a mass of other bodies. These latter bodies are revealed after fixation in Flemming without acetic, Zenker's fluid, corrosive, acetic, and alcoholic fixatives, and correspond to the structures described by Horning as mitochondria. Horning did have a faint suspicion that the bodies might be bacteria, but disproved this idea to his own satisfaction by fixing some of the organisms in absolute alcohol and staining in the Heidenhain's hæmatoxylin. He argued that if bacteria are present they should be stained, under these conditions ; but, on the other hand, if it were mitochondria with which he was dealing, they would be dissolved away by alcohol. He found an entire absence of included bodies, and therefore decided that the structures under consideration were mitochondria.

CONCLUSIONS.

Sporozoa.—We have shown the presence in the Sporozoa of a Golgi apparatus. This agrees with the metazoan apparatus in its reactions to osmic acid, and in general structure shows a resemblance to that of the Golgi apparatus of many metazoan cells. It also shows the juxta-nuclear position characteristic of the usual apparatus in higher forms, and during cell divisions the Golgi elements are drawn to each nucleus in approximately equal numbers, thus exhibiting similar behaviour to that of metazoan Golgi bodies in dictyokinesis. It thus appears that we are fully justified in proclaiming the presence of a true Golgi apparatus in the Sporozoa.

With regard to the other groups there is no such certainty. It is extremely difficult to give exact criteria for the Golgi apparatus; in fact, no basis for the identification of Golgi material in Protozoa has yet been agreed upon. The fact that the Sporozoan Golgi apparatus has those characteristics of the metazoan apparatus dealt with above may not necessarily mean that the apparatus in other Protozoa will fulfil all the conditions.

Sarcodina.—In Amœba, Brown describes a " Golgi apparatus " consisting of globules and spherules with clear centres and dark rims, which impregnate with osmic acid. These may represent the true Golgi apparatus, but we refrain from passing a definite verdict in the absence of other characteristics mentioned above, i.e. silver impregnation, juxta-nuclear position, or any indications of dictyokinesis.

Flagellates and Ciliates.—As to the exact nature of the Golgi apparatus in flagellates and ciliates there is still much confusion. The evidence against the homology of the Euglenoid stigma with the Golgi apparatus seems complete, but the parabasal theory and the contractile vacuole hypothesis have not yet been overthrown entirely. With regard to the parabasal, though it is found only in certain forms, its behaviour during division, and the resemblances to the Metazoa of its connections with other cell inclusions, are points which must not be overlooked. Again, concerning Nassonow's work, the fact that in certain cases the contractile vacuole has no lipoid cortex does not prove that in those cases in which the lipoid membrane is present it is not to be regarded as Golgi substance. Some workers, rejecting homologies such as these, which involve structures of isolated occurrence, have attempted to establish as Golgi material scattered bodies which in morphology and in behaviour to osmic acid show resemblances among themselves and also with the Golgi bodies of certain Metazoan cells, chiefly among invertebrates. Yet it seems, on the whole, that the evidence that such elements are Golgi bodies is inadequate, both as regards chemical reactions and general behaviour, for there is a complete absence of any clumping of these bodies to two portions at cell division. The faulty results of Horning in his study of ciliates impress upon us the extreme importance of accuracy of technique when dealing with the cytoplasmic inclusions of these Protozoa. In attempting to reveal the Golgi apparatus greater emphasis must be laid on proper differentiation and correct osmication period. Structures obtained by methods other than osmic impregnation can be identified as Golgi material only with the greatest reserve ; on the other hand, osmication alone cannot be accepted as a reliable criterion, but should be supported by a study of the reaction to silver methods.

We thus reach the conclusion that in flagellates and ciliates, though there is some proof for the evidence that the parabasals and excretory apparatus in some forms show resemblances to the metazoan Golgi apparatus, yet we can point to no cell inclusions which are similar in all, and which agree with all the criteria for the metazoan Golgi bodies. Possibly in some cases, e.g. Opalina, the Golgi apparatus is in a somewhat elementary condition, and the

parabasal apparatus may also represent a not wholly differentiated Golgi apparatus. It remains then for future workers to elucidate further the nature of the Golgi apparatus in the Protozoa.

EXPLANATION OF TEXT-FIGURES.

FIG. 1.—Basal apparatus in *Bodo lacertæ* (Belar) after Wilson.
    A, B, normal vegetative individuals with blepharoplasts (*b*), basal ring (*r*), and parabasals (*p*).
    C, initial stage of division ; D, later stage ; E, metaphase ; F, telophase.
FIG. 2 after Brown.—Smears fixed in Champy's fluid.
    A.—*Torquenympha octoplus* showing parabasals.
    B.—*Microjœnia ratcliffei* showing so-called Golgi bodies present as rings and spheres.
FIG. 3.—*Amœba proteus* fixed and stained by Bowen's modification of Mann-Kopsch procedure—showing " Golgi bodies " after Brown.
FIG. 4.—A.—*Euglypha alveolata* (after Hall) neutral red preparation, showing neutral red globules scattered among vacuoles of alveolar zone.
    B.—Kolatchewosmic impregnation bleached in turpentine, osmiophilic granules scattered in alveolar zone.
FIG. 5.—Modified Kopsch preparations—after Ludford.
    A.—Cell at beginning of secretion—Golgi bodies (GB) are beginning to scatter and some appear applied to surface of clear vacuoles (V).
    B.—Preparation bleached with hydrogen peroxide and stained with neutral red. Later stage showing relation of Golgi bodies to formation of secretion (V).

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

The History of Staining.—H. J. CONN (" The History of Staining : Joseph von Gerlach, Paul Ehrlich, Walther Flemming, Paul Mayer," *Stain Technol,* 1933, **8**, 41–52, 4 pl.). Biographical notes with excellent portraits of four famous figures in the history of histology. Their main contributions to histology are briefly described.　　　　　　　　　　　　　　　　　　　　　　　　　　　　　G. M. F.

A New Method of Dye Analysis.—A. GOLD and A. E. STEARN (" Note on a New Method of Dye Analysis," *Stain Technol.,* 1933, **8**, 53–60, 1 text-fig.). It was shown by Holmes (1929) that the combination between methylene blue and eosin takes place stoichiometrically without appreciable adsorption of the dye present in excess upon the precipitate. Positive and negative ions may thus be titrated with one another conductometrically. Technical details are given of the method which appears to give values reproducible to about 1 p.c. Difficulty has been experienced in preparing a satisfactory primary standard, so that data on the quantitative analysis of stains are not at present available.　　　　　G. M. F.

Apparatus for Histological Specimens.—J. C. SNYDER (" Apparatus for the Simultaneous Handling of Numerous Histological Specimens," *Stain Technol.,* 1933, **8**, 61–3). The apparatus described is of use in handling a large series of histological specimens. Bakelite is cut into circular plates $2\frac{3}{4}$ inches in diameter and individual compartments—a maximum of thirty-seven—are drilled out. The holes, $\frac{1}{4}$ inch in diameter, are drilled three-fourths of the distance ($\frac{3}{16}$ inch) through the plates and then $\frac{1}{16}$-inch holes are drilled entirely through the plate in the centres of the bottoms of the $\frac{1}{4}$-inch holes. The small holes permit the passage of reagents from one compartment to another. Any desired number of these plates may be fastened together by drilling two small clamp holes $\frac{3}{32}$-inch in diameter in each plate.　　　　　　　　　　　　　　　　　　　　　　　　　　　G. M. F.

The Staining of Striated Muscle.—W. G. MILLAR (" Observations on Striated Muscle," *J. Path. and Bact.,* 1933, **37**, 127–36, 5 pl., 1 text-fig.). Kull's method for staining mitochondria gives excellent results on striated muscle, both voluntary and cardiac, and has the advantage that the main striations are shown in two distinct colours. The fixative used is Kelly's sublimate-bichromate-formalin fluid, which gives excellent results on adult mammalian tissue. Material is taken through in the ordinary manner, thin sections are cut and taken down to water. The staining solutions used are : (i) Altmann's aniline oil-acid fuchsin :

acid fuchsin 7 p.c. in aniline-oil water; (ii) Aurantia, 0·5 p.c. in 70 p.c. alcohol; (iii) toluidine blue, 0·25 p.c. aqueous solution. The method of staining is as follows : Stain in the acid fuchsin, heating the stain to steaming and leaving for a few minutes, usually 2–4. Wash off rapidly in water and mop the slide free from excess water. Differentiate in the aurantia solution. The time taken varies, but is usually of the order of 10–20 seconds. After about this time the fuchsin is seen to come out in a slight red cloud when the slide is rocked, and this is the signal that the process has gone far enough. After differentiation the section, if composed mainly of normal muscle, is of an orange colour with a definite shade of red. Rinse off the aurantia in running water and mop slide. Stain in toluidine blue. The length of time varies with the activity of the sample of stain, but about 10 seconds may be given as a basis for experiment. Over-staining in the blue should be avoided, as it tends to lead to over-differentiation of the aurantia in the next stage. Differentiate the blue with methylated spirit. This step is also rapid and takes only a few seconds. Usually the ordinary duration in spirit for the dehydra-tion of the section is sufficient. Complete the dehydration in absolute alcohol, clear in xylol, and mount in balsam. The preparations should be examined with an oil-immersion objective, preferably apochromatic. The coverslip must not be too thick and not too much balsam should be left between it and the section. The slide should be of 1·0 to 1·2 mm. in thickness. As an illuminant, the usual opal gas-filled electric lamp with a " daylight " filter is suitable, but for critical work with the oil-immersion a Pointolite suitably dimmed with neutral tint wedges is essential, since with this arrangement the actual light source may be focused on the object and the resulting definition, particularly of fine coloured detail, greatly improved. A short account of the finer details of striated muscle under varying conditions is given.   G. M. F.

A Theory of Vital Staining.—M. GUTSTEIN (" Zur Theorie der Vital-färbung," *Ztschr. Ges. Exp. Med.*, 1932, **82**, 479–524). The vital staining of yeasts by basic dyes depends upon the relative solubility of the dye in the lipoid solvent and in the cell substances : its reducibility by the plant cell and its precipitability by Cranner's phosphatide (a water soluble substance isolated from the ectoplasm of plant cells). The fundamental difference between acid and basic stains in their action on the animal cell is that the latter form a stable union while the former merely enter into solution in the cell subsance. It is suggested that the accumula-tion of acid stains by certain animal cells depends on a difference in H-ion concen-tration on the two sides of the cell membrane.   G. M. F.

A Modification of the Mallory Heidenhain Connective Tissue Technique. —M. KOSTOWIECKI (" Über die Anwendung von Anilinblau und Orange G. zur färberischen Darstellung der skelettbildenden Gewebe (Modifikation der Mallory-Heidenhainschen Bindegewebsfärbung," *Ztschr. f. Wis. Mkr.*, 1933, **49**, 337–40). The method is especially useful for the tissues of young embryos before the develop-ment of connective tissue fibres. Sublimate fixatives are best, but other fluids may be used if treatment with 3 p.c. sublimate precedes staining. Dissolve 0·2 gm. of orange G and 0·06 gm. of aniline blue in 100 c.c. of distilled water ; boil for 3 minutes and add to the hot solution 1 gm. of phosphomolybdic acid ; cool and filter. The stain keeps for 2 months. Paraffin sections after staining with paracarmine are passed down to distilled water and stained for from 30 minutes to 12 hours. Rinse in distilled water, 1 minute in 95 p.c. alcohol, then into absolute and into xylol preferably for 30 minutes. Results : precartilage, light ultramarine ; cartilage, Berlin blue ; connective tissue fibres, dark blue ;

regions of ossification and bones, light marine blue. In very young embryos the cytoplasm is bluish in all tissues except the muscles, which stain orange. In older embryos cytoplasm is light orange; red blood cells, orange; nuclei, brick-red to reddish-violet; cornified epithelia are orange-yellow in early stages and yellow when fully cornified. G. M. F.

The Staining of Bacterial Capsules.—J. W. CHURCHMAN and N. V. EMELIANOFF ("A New Method for Staining Bacterial Capsules," *Proc. Soc. Exp. Biol. and Med.*, 1932, **29**, 514–5). Flood air-dried smears with 10 drops of Wright's stain; leave until the stain has nearly, but not completely, evaporated to dryness, when a pinkish colour replaces the original blue. This generally takes from 3 to 4 minutes. Wash off as rapidly as possible with Clark and Lub's buffer solution (*p*H 6·4 to 6·5); distilled water is sometimes preferred. Dry by fanning without blotting. The pneumococcus, *B. anthracis, Klebsiella pneumoniæ* Friedlander showed pink capsules against the blue organisms. Precipitation of the stain may cause granular deposits and ring-like structures, but these can soon be determined as artefacts. G. M. F.

Further Observations on the Staining of Bacterial Capsules.—J. W. CHURCHMAN and N. V. EMELIANOFF ("A Study of the Bacterial Capsule by New Methods," *J. Exp. Med.*, 1933, **57**, 485–510). Certain modifications of Wright's stain have given good results, such as the substitution of ethyl alcohol or glycerine for methyl alcohol and the use of Giemsa's stain or the tetrachrome stain. The method produces appearances resembling capsules around the somata of a number of non-capsulated organisms. G. M. F.

Phenosafranine for Staining Colonies on Culture Media.—E. J. MOORE ("The Use of Phenosafranine for Staining Fungi on Culture Media or in Host Tissue," *Science*, 1933, **77**, 23–4). This method is very suitable for staining bacterial or fungal colonies on an agar substrate. The medium does not absorb the phenosafranine as readily as the cells, so that the latter stand out intensely against the lighter background. The following formula is recommended: Carbolic acid crystals, 20 gm.; lactic acid syrup, 20 gm.; glycerine, 40 gm.; distilled water, 20 gm.; phenosafranine, 0·5 gm. or less. With fixed sections mordanting with 2 p.c. iron alum for 2 hours should be carried out. Destain with 0·5 p.c. alum dissolved in 0·5 p.c. HCl or with alcohol. Intensify the stain with 1 p.c. ammonium hydroxide. G. M. F.

The Physical Chemistry of Histological Staining.—MASJI SEKI ("The Physical Chemistry of Histological Staining. I. Preliminary Electrical Charge of Dyes and its Rôle in the Dying of SiO_2," *Folia Anat. Jap.*, 1932, **10**, 621–34. "II. Substantive Dyeing of Fixed Histological Preparations," *ibid.*, 1932, **10**, 635–54). Cataphoretic studies of thirty-one acid and twenty basic dyes in agar gel at *p*H7 show that all basic dyes migrate to the cathode and all acid dyes to the anode. Negatively charged SiO_2 is dyed at *p*H 7 by all basic dyes, but not by the acid dyes. Since most preparations of tissues are on the alkaline side of the isoelectric points of the constituents, basic dyes stain by adsorption; as the *p*H increases dyeing becomes more intense. Acid dyes having a similar charge to that of the substrate constituents colour by "infiltration" and are easily washed out by water. Molecular size, with proportionate speed of diffusability, is important, as is also a tendency to form insoluble precipitates. Dyes of low molecular size and high diffusibility easily penetrate all parts of tissue, whereas large dye molecules can penetrate only tissues with wide "pores." G. M. F.

The Staining of Endospores.—A. B. SCHAEFFER and M. FULTON (" A Simplified Method of Staining Endospores," *Science*, 1933, **77**, 194). Films of bacteria are fixed by flaming three times. Flood with 5 p.c. aqueous malachite green and heat to steaming three or four times within $\frac{1}{2}$ minute. Wash off the excess of stain for about $\frac{1}{4}$ minute and apply 0·5 p.c. aqueous safranine solution for the same time. Wash, blot, and dry. Spores are green, cells red. There is no blending of the colours.   G. M. F.

Staining of Bacteria as a Function of *p*H.—P. LASSEUR, A. DUPAIX, and L. GEORGES (" Observations sur la fixation des colorants par les corps microbiens en fonction de *p*H," *Compt. rend. Acad. Sci.*, 1933, **196**, 1749–51). In distilled water bacteria and the cells of fungi are negatively charged, except about *p*H3, when the charge is reversed. This electrical charge accounts for the fixation of dyes such as Bordeaux blue or aniline blue. Both electrical charge and the idea of surface activity must be taken into account in staining with Nigrosin, congo red, safranine, or methylene blue.   G. M. F.

Nigrosine and the Negative Staining of Infusoria.—G. DEFLANDRE (" Sur l'introduction de la nigrosine dans la technique des frottis secs d'infusoires," *Ann. de Protist*, 1929, **2**, 121–4). A drop of the organisms, either living or in a suitable fixative, is placed on the slide and a drop of aqueous nigrosine (5–10 p.c.) is added. Mix and spread uniformly, drying as fast as possible, in a draft or by fanning the slide ; mount in Canada balsam. The addition of a little acid fuchsin to the nigrosine solution is an advantage, as the organisms are coloured pink on a grey background. If mere traces of acid fuchsin are added the infusoria remain colourless for a few days, after which they assume a pink colour on a grey background. If sufficient fuchsin is added to stain the protozoa instantly, the colour will become so intense in a short time that the preparations will be unusable for some years. The fuchsin, however, eventually fades in the balsam, so that the preparations are not permanent.   G. M. F.

A Stain for Vaginal Smears.—W. K. CUYLER (" A Differential Stain for Dried, Unfixed, Vaginal Smears," *J. Lab. and Clin. Med.*, 1932, **18**, 314–5). The following stain is recommended for studies of the complete œstrous cycle of the white rat. Five vaginal smears, in $\frac{1}{2}$-inch areas, are made at suitable intervals on a single slide and allowed to dry. The slides are placed in 95 p.c. alcohol for 3 minutes, in distilled water for 1 minute and in Harris' or Delafield's hæmatoxylin for 20 minutes. They are then washed in tap water for 2 minutes, in alkaline alcohol (70 p.c. alcohol made by using a 4 p.c. solution of ammonia in water instead of distilled water), and counter-stained 8 hours or over-night in the following : Indigo-carmine (Grübler), 0·25 gm. ; eosin γ (Coleman and Bell), 1 gm. ; distilled water, 99 c.c., with the addition of a pinch of thymol. The slides are washed quickly in tap water, dehydrated in alcohol, cleared in xylol, and mounted in Canada balsam. Nuclei of epithelial cells, grey ; cytoplasm, lavender ; cornified cells, bright pink ; nuclei of leucocytes, dark ; cytoplasm, clear ; red blood cells, pink.   G. M. F.

Quantitative Microincineration.—G. H. SCOTT (" Quantitative Estimation of Ash after Microincineration," *Proc. Soc. Exp. Biol. and Med.*, 1933, **30**, 1304–5). By dark field illumination the appearance of ashed preparations is that of hoar frost on a blackened surface. With this means of illumination only the ash of the section is revealed by light reflected from the surfaces of the individual particles of minerals. It is therefore assumed that as the particles are approximately of

the same size and nature, the more mineral present in the microscopic field, the greater the quantity of light reflected into the eye of the observer. This assumption has been checked by examining colloidal solutions at different dilutions with the dark field microscope, with the result that given a constant source of light the intensity of the beam emerging from the ocular is roughly proportional to the number of particles in the microscopic field. Consequently measurement of the intensity of the light reflected from the ash provides a means of estimating its quantity. Particulars of the practical application of the technique are given.

G. M. F.

Methods of Staining the Anterior Pituitary.—T. MARTINS ("Sur les méthodes de coloration histologique de l'hypophyse antérieure," *Compt. rend. Soc. de Biol.*, 1933, **113**, 1275–6). For the pituitaries of small animals such as the rat the following technique is recommended. Fix in Helly's fluid for 1 hour at 37° C. or for 2–2½ hours at room temperature, wash in water and pass through the alcohols, xylol to paraffin. Sections should be passed through 70 p.c. alcohol containing iodine, then into 70 p.c. alcohol and into water. After staining in hæmalum (Mayer, Delafield or Harris) for 2–3 minutes, wash thoroughly in water; then pass into acid fuchsin (1 in 1000) for about 10 seconds. Immerse in phosphomolybdic acid (1 p.c.) for 1–2 minutes; drain off excess of fluid and pass directly into methyl blue (0·5 p.c.) for 2–3 minutes. Wash quickly in water and pass rapidly through the alcohols to xylol.

G. M. F.

Champy-Kull Staining of Unsectioned Cells.—W. L. DOYLE ("Method for Study of Unsectioned Cells with Champy-Kull Staining," *Anat. Rec.*, 1932, **53**, 167–8). The method was applied in a study of mitochondria and Golgi bodies in the germ-cells of the fungus gnat, Sciara. Dissect out the testis in a saline solution isotonic with the germ-cells; transfer to the following mixture: formalin (neutralized with $MgCO_3$), 0·9 c.c.; Sørensen's phosphate buffer, 1 c.c. (pH range between 6·4 and 7·2); Ringer's salts as required for isotonicity; water to 9 c.c.; wash in four changes of distilled water for a period of 1 hour; transfer to 2 p.c. osmic acid for from 4 to 6 days at 30° C.; then to water at 30° C. for 24 hours; semimacerate by dehydration in glycerine (from 10 to 100 p.c. in 6 hours). Leave in pure glycerine for 8–12 hours; rehydrate to 10 p.c. glycerine in 6 hours and transfer to water for 1 hour; treat with "superoxal" 0·3 p.c. in water for 10–25 minutes; transfer from vial to hollow slide and crack the test with gentle pressure from a needle. Stain with the Champy-Kull procedure, pipetting the stains into the depression of the slide, then pass through bergamot oil to xylol. Transfer to a drop of Canada balsam on a slide and break up the testis with a needle to obtain small groups or isolated cells.

G. M. F.

Microchemical Tests for Fats.—V. NATH ("Microchemical Tests for Fats, Lipoids, and Vacuoles, with Special Reference to Oogenesis," *Quart. J. Micr. Sci.*, 1933, **76**, 129–44). The time required by osmic acid to blacken any particular sample of fat or lipoid depends entirely on its degree of unsaturation and its previous state of oxidation. A completely hydrogenized fat, with iodine value nil, does not blacken in osmic acid even when kept at 40° C. for 7 days. It follows, therefore, that a granule in a cell which blackens rapidly in osmic acid cannot be identified as true fat unless it also stains in Sudan III and Scharlach. At some stage of the oogenesis of Ophiocephalus, Rana, Emyda, Gallus, Luciola, Periplaneta, Palæmon, and Paratelphusa the Golgi material is changed from lipoid to fat.

G. M. F.

The Intensity of Nuclear Staining.—D. MAINLAND ("Colorimetric Tests of Nuclear Staining," *Stain Technol.*, 1933, 8, 69–72). By a scale made from water-colour pigments placed near the magnified images of nuclei projected on a screen it was demonstrated mathematically that, for a given specimen, nuclear staining intensity varies inversely with nuclear volume. The most probable explanation is that in the larger nuclei there is greater separation of the chromatic particles.

G. M. F.

Fast Green.—L. A. MARGOLENA ("Concerning Fast Green," *Stain Technol.*, 1933, 8, 73). Fast green dissolved in either 95 p.c. alcohol or in clove oil offers a very satisfactory counter-stain for hæmatoxylin, for Feulgen's reaction, or for differentiating safranin after most commonly used fixatives. Dissolved in alcohol, it is a satisfactory stain for erythrocytes or for blood smears treated by Feulgen's method. It is a fairly strong stain and 0·25 p.c. solutions seem to stain sufficiently deeply.

G. M. F.

An Improved Method of Staining Tubercle Bacilli in Sputum.—P. DOGLIO (*Giorn. Batteriol. e Immunol.*, 1932, 8, 243). After staining with the usual Ziehl-Neelson's carbol fuchsin, wash well in running water. Counter-stain and differentiate 40–50 seconds with the following solution. Brilliant green, 0·15 gm.; conc. sulphuric acid, 10 c.c.; alcohol, 20 c.c.; water, 85 c.c. Wash thoroughly and blot. The bacilli are red on a lemon-yellow background. The method, while just as reliable as the usual technique, is more rapid, and reveals the organisms more clearly, thus facilitating diagnosis.

G. M. F.

The Staining of Tubercle Bacilli in Sputum.—L. A. MARGOLENA ("Notes on the Staining of Tubercle Bacilli in Sputum," *Stain Technol.*, 1932, 8, 243). Doglio's method is recommended for its rapidity. The possibility of questioning the acid fastness of an organism when it lies on or between leucocytes is eliminated. In connection with the standard technique, alkaline methylene blue is much improved by using in greater dilution, while plain aqueous or aqueous alcoholic methylene blue gives as good results as the alkaline solution.

G. M. F.

The Staining of Tubercle Bacilli in Tissues.—M. G. DOUGLAS ("Cooper's Modification of the Ziehl-Neelson Staining Method as applied to Tubercle Bacilli in Tissue," *J. Lab. and Clin. Med.*, 1932, 17, 1131–2). Paraffin sections, brought down to water, are flooded with carbol fuchsin with 3 c.c. of a 10 p.c. aqueous solution of NaCl per 100 c.c. of the solution added, and placed in an incubator at 37° C. for two hours or overnight at room temperature. They are transferred to the ice-box for 30 minutes—this precipitates the stain—then washed in water and decolorized for about 1 minute with 5 p.c. nitric acid in 95 p.c. alcohol. After washing the sections are counter-stained with methylene-blue-azure for 10 minutes. This stain is prepared by mixing equal parts of 1 p.c. azure II and Mallory's 1 p.c. methylene blue in 1 p.c. borax, diluting before use with 18 parts of water. After staining, wash in water, differentiate in 95 p.c. alcohol with colophonium, dehydrate, clear, and mount. More tubercle bacilli are said to be revealed than by the usual staining methods.

G. M. F.

Glycerine and the Staining of Bacteria.—F. M. HUNTOON ("Glycerin as an Adjuvant to Bacterial Dyes," *Amer. J. Clin. Path.*, 1931, 1, 317–9). Glycerine is recommended as a substance which tends to stabilize solutions, at the same time the microscopic picture is clearer. For Gram's stain mix 15 parts of 3 p.c. crystal violet in 95 p.c. alcohol with 85 parts of 30 p.c. aqueous glycerine. As counter-stains may be used (a) Carbol fuchsin, 10 c.c. mixed with 100 c.c. of a 25 p.c.

aqueous glycerine, (b) Bismarck brown, 2 gm. mixed with 100 c.c. of water and filtered; 30–40 c.c. of glycerine is added and well mixed. The usual Gram's iodine is used, while for decolorization 75 parts alcohol to 25 parts acetone are employed. For staining tubercle bacilli, glycerine crystal violet with Bismarck brown as above may be used, or glycerine may be added to fuchsin, prepared as follows: 5 p.c. phenol, 75 c.c.; glycerine, 25 c.c.; saturated solution of basic fuchsin in 95 p.c. alcohol, 10 c.c. This combination stains as well as the usual carbol fuchsin, but does not precipitate either in the bottle or when boiled. Loeffler's methylene blue is modified as follows: saturated solution of methylene blue in 95 p.c. alcohol, 10 c.c.; 1 p.c. solution of sodium hydrate, 1 c.c.; 25 p.c. aqueous glycerine, 100 c.c. This solution gives a sharper picture than usual.

G. M. F.

Cytology.

Synovial Cells in Tissue Culture.—E. VAUBEL (" The Form and Function of Synovial Cells in Tissue Cultures. I. Morphology of the Cells under Varying Conditions," *J. Exp. Med.*, 1933, **58**, 63–84, 3 pl. " II. The Production of Mucin," *ibid.*, 1933, **58**, 85–96). Synovial cultures are more closely allied to chondroblasts and osteoblasts than fibroblasts. The cells exhibit polymorphism with all transitions from round to spindle; eventually they form an epithelial-like membrane, composed of cells with numerous syncytial bridges. Globular cytoplasmic inclusions which stain easily with neutral red and sometimes with toluidine blue are present. Typical synovial cells elaborate a mucin-like substance, but transformation of synovial cells into fibroblasts is accompanied by loss of mucin production. Marked tendency to liquefaction of the plasma about the growths was observed.

G. M. F.

The Toxic Action of Cations on Fibroblasts Grown in vitro.—J. VERNE and C. SANNIE (" Etude de l'action toxique des cations sur les fibroblastes cultivés *in vitro*," *Compt. rend. Acad. Sci.*, 1933, **196**, 1246–7). Fibroblasts from chick embryo heart were used as test objects; the metals were given in the form of chlorides. Metals could be classified into five groups: (i) Cations lacking all toxicity—all alkalis (except NH_4) Ca, Mg. (ii) Cations feebly toxic—NH_4, Sr, Ba, Mn, inhibitory in concentrations of $N/120$ to $N/150$. (iii) Fe, Pb, Al, UO_2, Be, Y, Pr, La, Dy, Th, inhibitory in concentrations of $N/200$ to $N/1000$. (iv) Toxic metals—Ce, Tl, Ni, Co, Au, Pt, Cu, Zn, inhibiting in dilutions of $N/1000$ to $N/5000$. (v) Very toxic metals, above $N/10,000$, Cd and Mg.

G. M. F.

The Staining of the Head of the Spermatozoa of Gastropods.—O. TUZET (" Sur la colorabilité de la tête des spermies de Gastéropodes," *Compt. rend. Soc. de Biol.*, 1933, **113**, 653–4, 10 text-figs.). By Mann's method the heads of the spermatozoa of Gastropods are seen to be composed of two kinds of chromatin, basichromatin which stains blue, oxychromatin which stains red. Oxychromatin, however, is of two kinds, one which stains with Feulgen's technique, the other which does not.

G. M. F.

The Effect of Physical Factors on the Cytoplasm of Amœba.—S. O. MAST and C. L. PROSSER (" Effect of Temperature, Salts, and Hydrogen-ion Concentration on Rupture of the Plasmagel Sheet, Rate of Locomotion, and gel/sol Ratio in *Amœba proteus*," *J. Cell and Comp. Physiol.*, 1932, **1**, 333–54, 4 text-figs.). The gelated layer surrounding the central fluid mass in *Amœba proteus* is very thin at the anterior end. It is here called the plasmagel sheet and frequently ruptures during locomotion. The higher the temperature and the lower the salt concen-

tration and the hydrogen-ion concentration the more frequent are the ruptures. The frequency of ruptures is directly correlated with the gel/sol ratio. Four salts were tested, NaCl, KCl, $CaCl_2$, and $MgCl_2$, for their effect on the gel/sol ratios. To produce a given ratio it requires a stronger solution of NaCl than of $CaCl_2$ or $MgCl_2$. G. M. F.

Vital Staining of Cancer Cells.—R. C. TILGHMAN and F. C. LEE (" The Vital Staining of Rabbit Carcinoma," *Bull. Johns Hop. Hosp.*, 1931, **49**, 360–87). Rabbits with experimental carcinoma of the testes were given intravenous injections of 1 p.c. aqueous trypan blue either alone or followed by carmine. The carmine solution used was 5 p.c. carmine rubrum optimum (Grübler) in a saturated solution of lithium carbonate, heated on a water bath for 15 minutes and filtered. The tumours from rabbits which received injections of both dyes showed no single typical picture, but all showed separate and distinct blue and purple areas diffusely mingled in irregular patterns in the various tumours. Microscopically, in animals injected with trypan blue alone, the dye accumulated primarily in the phagocytic wandering mononuclear cells which were situated in great numbers in the stroma surrounding the tumour nodule. In the animals receiving both carmine and trypan blue the oldest carcinoma areas stained predominantly blue, the youngest red, while a mixture of the two colours was seen in the regions of intermediate cancer growth. In the phagocytic cells, granules of either or more often of both dyes were observed, but cells were never seen in which one vacuole contained particles of both dyes. G. M. F.

Histogenesis of the Rous Sarcoma.—A. HADDOW (" The Application of Vital Staining to the Histogenesis of the Rous Sarcoma, I," *J. Path. and Bact.*, 1933, **37**, 149–55, 1 pl.). By the application of the vital staining technique it is shown that after inoculation of active cell-free sarcoma filtrate the tumour is derived from previously normal cells under the influence of the agent. From the morphology of the cell and its content and distribution of segregated dye it is shown that the unit initially affected is the free histiocyte, which must therefore be regarded as the parent cell of the Rous sarcoma. G. M. F.

Cellular Response of the Vitreous Humour.—W. A. GRAY (" Cellular Response of Vitreous Humour to Infection of Bacteria, Blood, and Vital Dyes," *J. Path. and Bact.*, 1933, **37**, 137–48). The first cells to respond to the presence of irritation in the vitreous are the polymorphonuclear leucocytes. They are quickly followed by macrophages: in the later stages of the inflammation, as the polymorphonuclear leucocytes diminish, the macrophages increase. The cellular exudate in inflammation of the vitreous is derived almost entirely from the neighbouring vascular structures, but occasionally there is proliferation of the periadventitial histiocytes at the optic disc. G. M. F.

The Common Fibroblast and its Growth in Serum.—C. R. PARKER (" The Races that constitute the Group of Common Fibroblasts. II. The Effect of Blood Serum," *J. Exp. Med.*, 1933, **58**, 97–113, 4 pls.). Under suitable conditions fibroblasts are able to multiply in serum, at a slow rate for very long periods. The rate of multiplication of fibroblasts in a given sample of serum depends entirely on the nature of the strain, cell races endowed with a high residual growth energy multiplying more rapidly than those with growth potencies of a lower order. The first effect of serum on fibroblasts is invariably injurious, the degree of injury differing according to the nature of the cell strain and the age of the animal from which the serum is derived. With the passage of time, the colonies undergo

gradual improvement, both in the appearance of the component cells and in their rate of proliferation. In media containing embryonic tissue juice or other growth-activating substances, fibroblasts form colonies that are isomorphic and composed of isomorphic cells. In serum fibroblasts form colonies of heteromorphic appearance. Each colony becomes composed of cells that differ from those of other colonies. G. M. F.

The Histochemical Detection of Cholesterol.—W. L. DOYLE (" A propos de la détection histochimique de cholestérol," *Bull. d'Hist. appliq.*, 1933, **10**, 20–1). It is usually believed that cholesterol is isotropic, but it is suggested that the absence of apparent optic activity is due either to the dissolved state of the cholesterol or to the fact that certain lipoids in the cell are present in a masked condition. Digitonine has a lipolytic action, and thus should unmask cholesterol, while it may form anisotropic crystals of a complex digitonine-cholesterol. G. M. F.

Arthropoda.

Arachnida.

Aturus (Crinaturus) spatulifer Piersig.—C. MOTAŞ (" Aturus (Crinaturus) spatulifer Piersig in den rumänischen Karpathen," *Zoologischer Anzeiger*, 1933, **103**, 13–8, figs. 1–5). Describes the previously undescribed ♀ of this species and furnishes details lacking in Piersig's description of the ♂. BM/HNDH

Fourth Contribution on Mites from Underground Waters.—VIETS (" Vierte Mitteilung über Wassermilben aus unterirdischen Gewässern (Hydrachnellæ et Halacaridæ, Acari)," *Zoologischer Anzeiger*, 1933, **102**, 277–88, figs. 1–10). Extends our knowledge of the mite fauna of the Balkans in so far as it relates to the underground waters (*vide* p. 49, *ante*). Under the division Hydrachnellæ Latr. we have descriptions of the nymph of *Acherontacarus halacaroides* Viets, the male of *Lethaxona pygmæa* Viets, and the female of *Megapus subterraneus* Viets. To the Halacaridæ belongs a new species, *Parasoldanellonyx typhlops*, which appears to be the first halacarid recorded from fresh water in the Balkan area. Opportunity is taken to review the Halacaridæ as a family, and tables show the marine and fresh-water forms grouped according as they are predatory, vegetable eaters, or parasitic in habit. A further review on systematic lines shows the halacarids divisible into fam. Halacaridæ s.str. Murray—the marine forms without external genital discs, with five subfamilies—Rhombognathinæ, Halixodinæ, Halacarinæ, Lohmannellinæ, and Simognathinæ and a new family, Porohalacaridæ—the forms with external genital discs, living in fresh water with four subfamilies—Porohalacarinæ, Limnohalacarinæ, Porolohmannellinæ, and Astacopsiphaginæ. BM/HNDH

The Thyasid Mites.—LUNDBLAD (" Zur Kenntnis von *Lundbladia petrophila* (Michael) und der verschiedenen Entwicklungsrichtungen bei den Thyasinen," *Zoologiska bidrag från Uppsala*, 1933, **14**, 219–52, 14 figs.). It is now almost 100 years since C. L. Koch established *Thyas* as a genus with *venusta* as its only species. With the passing of time other species came to the knowledge of zoologists, and new genera were erected from time to time to cover the increasing number of species embraced in the subfamily Thyasinæ. After an exhaustive study of *Lundbladia petrophila*, better known in the past as *Thyas (Panisus) petrophilus*, Lundblad discusses at some length the component genera of the Thyasinæ, and

demonstrates by schematic figures how the equipment of dorsal plates may be used to separate the genera from one another. The communication concludes with an identification table, in which the genital acetabula form the primary characteristic. Sixteen genera, each with its type, are demonstrated, but one misses the presence of venusta as a type. Have the rules of nomenclature been overlooked—or rejected ? BM/HNDH

Tardigrada

The Water Bears of Europe.—L. GUÉNOT ("Faune de France, 24, Tardigrades," 1932, 1–96, 98 text-figs.). Those who are interested in this little-studied group of microscopic animals must welcome the publication of volume 24 of the "Faune de France." For the work constitutes really a revision of the European species of the Tardigrada, since it contains full descriptions (with synonyms) and figures of all the forms known to occur in the wider area, while indicating those not yet detected on French soil. After summarizing the history of the Tardigrades from the earliest published drawing of a water bear by Pastor J. A. E. Goeze, of Quedlinburg, in 1773 to the most recent years, the author goes fully into the morphology, entogeny, and ethology of the class. The succeeding classification is very simple and may be stated thus :

CLASSE DES TARDIGRADES.

ORDRE des ECHINISCI.

Famille des *Non-cuirassés.*

7 Genera : *Batillipes* (1), *Tetrakentron* (1), *Halechiniscus* (1), *Microlyda* (1), *Echiniscoides* (1), *Orcella* (1), *Parechiniscus* (1).

Famille des *Cuirassés.*

3 Genera : *Bryodelphax* (1), *Pseudechiniscus* (5), *Echiniscus* (20).

ORDRE des MACROBIOTI.

4 Genera : *Milnesium* (1), *Macrobiotus* (17), *Hypsibius* (24), *Diphascon* (10).

(Numbers in brackets denote the number of European species in the respective genera.)

The Tardigrades divide naturally into two orders, which are easily recognizable and are mainly distinguished by the presence of sundry cephalic appendages (Cirri) only in the Echinisci, most of these being further marked by the possession of the so-called cuirass, consisting of a series of hard chitinous plates which cover the dorsal and dorso-lateral portions of the body. These form the family of the Cuirassés, while the few species which are assigned to the family of the Non-cuirassés have simply a more or less leathery covering. The latter family is also noteworthy as including *Tetrakenton synaptæ*, the solitary parasitic form as yet discovered among the Tardigrades and as providing in the first five genera named above the few species known to live in sea water. The Macrobioti lack the cephalic appendages of the Echinisci and the cuirass of the Cuirassés and their species, like the non-marine Echinisci, live either in lochs or ponds or in mosses or lichens, even among those which grow in positions usually dry, for like certain nematoid worms and the majority of the bdelloid rotifera, the tardigrades are able to enter upon periods of

suspended animation when their habitat becomes dry and to resume active existence when they are again moistened by rain or by dewfall. A few of the forms barely exceed a millimetre in length, but the most of the species are of much smaller dimensions. The accurate determination of the several forms is by no means easy, especially in the larger genera, but should be much facilitated by the carefully constructed key provided.   D. L. B.

Rotifera.

Some Notes on the Genus Ascomorpha and on the Digestive Processes among Rotifera.—P. DE BEAUCHAMP ("Contribution à l'étude du genre Ascomorpha et des processus digestifs chez les rotifères," *Bull. Soc. Zool. France*, 1932, **57**, 428–49, 5 text-figs.). In a very useful paper the author gives figures and detailed descriptions of four out of the five species now considered valid in the above curious but difficult genus. For the fifth species, said to be the smallest rotifer yet known, but which he has not himself seen, he summarizes the particulars furnished by Von Hofsten, when describing it after its discovery in the Mästermyr. In the descriptions of the four species which he has been able to identify and to examine, he has entered very fully into the details of the digestive organs and the remarkable processes of digestion possessed by them, and he has more especially investigated these in the case of *Ascomorpha ecaudis*, the most common species of the genus and that particularly studied by Remane when making his research into the existence of intracellular digestion among certain rotifera (see *J.R.M.S.*, 1931, **51**, 157). As a result of these closer examinations, de Beauchamp declares himself in accord with Remane in his explanation of the process of digestion in this species, while supplementing it with some further details. The importance of this matter lies in the fact that in this exceptional method of digestion the genus *Ascomorpha* does not stand alone among Rotifera, but is representative of a number of scattered species, all of which had formerly been looked upon as simply harbouring Zoochlorellæ within the body cavity, whereas it now appears certain that the Chlorellæ (as they must now be called), or other minute algæ, actually penetrate through the stomach wall into the body cavity of the rotifer, but do not escape being digested by so doing, although their disintegration may be considerably delayed. Further, that more or less abnormal changes have been brought about in the digestive organs and processes of the rotifers studied and probably in most of the other species whose bodies are apparently packed full of green or brown algæ.   D. L. B.

Protozoa.

Protozoan Fauna of Amoy.—C. C. WANG and D. NIE ("A Survey of the Marine Protozoa in Amoy," *Contr. Biol. Lab. Sci. Soc. China* (Zool. Ser.), 1932, **8**, 285). Working at the Marine Biological Station at Amoy, the authors made a survey of the protozoa in the local plankton. The organisms numbering eighty-four species, and belonging to the Rhizopoda, Mastigophora, and Ciliata, are all described and figured. The following infusoria are new : *Thoracophrya luciæ* var. *livida* var. n., *Glaucoma hyalina* sp.n. (Holotrichida), *Tintinnopsis minima* sp.n., *Codonellopsis rotunda* sp.n., *Favella amoyensis* sp.n., *F. undulata* sp.n. (Oligotrichida) ; *Holosticha simplicis* sp.n., *Strongylidium maritimum* sp.n., *Urostyla limboonkengi* sp.n. (Hypotrichida), *Cothurnia acuta* sp.n. (Peritrichida), *Acineta infundibuliformis* sp.n., *A. annulata* sp.n.   C. A. H.

Reactions to Illumination in Volvox.—S. O. MAST ("The Rate of Adaptation to Light and to Darkness in *Volvox globator*," *Zeitschr. vergl. Physiol.*, 1932, **17**, 644). In a previous publication the author demonstrated that change in illumination induces in *Volvox* series of processes opposed by other processes in the colonies in such a way that their effect becomes neutralized. The present paper deals quantitatively with this adaptation. The observations made on *V. globator* were conducted in a dark room. Illumination was obtained from lamps (25 W. to 1000 W.) mounted in such a way that a horizontal beam of light passed through the dark room several centimetres above a table containing the binocular microscope, the centre of the beam coinciding with the surface of the stage of the microscope. In making the observations, about 200 colonies in 5 c.c. water were put into a plate-glass aquarium, measuring 2·5 c.c. The results obtained show that *Volvox* may be photosensitive, photonegative, or neutral, according to conditions. In the first case a shadow on the photosensitive substance in the eyespots of the zooids causes their flagella to change their diagonal stroke to backward, while a flash of light on this substance causes change from diagonal to sidewise. If the colony reacts negatively the reverse obtains, and if it is neutral there is no response unless the changes in luminous intensity are great. The nature of the response to light in *Volvox* depends upon the state of adaptation and the intensity of illumination. If it is fully adapted, it becomes positive if the intensity is increased and negative if it is decreased. If it is not fully adapted, its behaviour is reversed. Further particulars are given regarding the time required for colonies of *Volvox* to become photosensitive (reaction time) under various conditions of illumination.

C. A. H.

Effect of Electric Current upon Amoeba.—W. F. HAHNERT ("A Quantitative Study of Reactions to Electricity in *Amœba proteus*," *Physiol. Zool.*, 1932, **5**, 91, 11 figs.). An investigation on the quantitative relation between the electric current used as a stimulating agent and the subsequent response on the part of *Amœba proteus*, as indicated by changes in the rate and direction of movement. The amœbæ used in the experiments were cultivated in a medium composed as follows: NaCl, 0·08 gm.; $NaHCO_3$, 0·004 gm.; HCl, 0·004 gm.; $CaCl_2$, 0·004 gm.; $CaH_4(PO_4)_2$, 0·002 gm.; Sorensen's phosphate buffer mixture (Na_2HPO_4, M/15, 2 c.c. + KH_2PO_4, M/15, 3 c.c. = pH 6·64); redistilled water, 1 litre. In this medium, distributed in small receptacles, the amœba was grown together with its food organism, *Chilomonas*. The actual observations on the action of the electric current were carried out in another medium, composed of $CaCl_2$ 0·008 gm., 10 c.c. of the buffer solution, and redistilled water 1 litre. The electricity was drawn from a 110-volt D.C. circuit, through two MacLagan rheostats to a reversing switch, then through a mercury contact key to sheet-platinum electrodes. A milliammeter was placed in line in front of the reversing switch. The observation slide consisted of a glass trough (70 × 10 × 5 mm.). Two porcelain plates were cemented across the trough, dividing it into three compartments: two for the electrodes and one for the amœbæ. In the experiments these compartments were filled with the test solution, and about twenty washed amœbæ were transferred to the central compartment, over which a coverslip was placed. When the slide was put upon the microscope stage the electrodes were inserted into the end compartments. Observations were made after the amœbæ became attached to the bottom of the slide. They are described in great detail and can be summarized as follows: the rate of locomotion in *Amœba proteus* under constant conditions is fairly constant over long periods of time. The nature of the response to a galvanic current in the amœba depends upon the direction of movement when the current is made and

upon the strength of the current. Individuals moving toward the cathode respond to sudden increase in the current density by increase in the rate of movement at the posterior end and decrease at the anterior end, resulting in contraction of the organism. Prolonged passage of a constant weak current causes an increase of locomotion lasting several minutes. Prolonged passage of a strong current brings about contraction followed by disintegration of the organism. Specimens moving toward the anode respond to sudden increase in current density by reversal in the direction of protoplasmic flow at the cathodal end, followed rapidly by cessation of flow at the anodal end. " Response to the constant electric current in *Amœba proteus* is due to local decrease in the elastic strength of the plasmagel on the cathodal side of the organism." C. A. H.

Cultural Requirements of Amœba.—W. F. HAHNERT (" Studies on the Chemical Needs of *Amœba proteus :* a Culture Method," *Biol. Bull.*, 1932, **72**, 205). A study on the relative importance of the individual salts in the culture medium for the maintenance of *Amœba proteus*. Amœbæ from stock cultures were washed repeatedly and placed in batches of about ten in beakers containing the different salt solutions. Washed *Chilomonas* served as food for the amœbæ. All the beakers were kept under the same conditions of lighting and temperature. The suitability of the salts was tested by daily observations on the number and physiological condition of the amœbæ. Solutions of the following salts were used in various combinations : $NaCl$, $NaHCO_3$, KCl, $CaCl_2$, $CaH_4(PO_4)_2$, $Mg_3(PO_4)_2$, $Ca_3(PO_4)_2$. It was found that the amœbæ grow and reproduce for several weeks in a balanced salt solution containing potassium chloride, calcium chloride, calcium phosphate, magnesium tribasic phosphate, and *Chilomonas*. The presence of sodium proved to be not only unnecessary but even harmful, while that of magnesium and potassium is favourable, but not essential for growth of the amœbæ. C. A. H.

Nutrition of Euglena.—H. DUSI (" Recherches sur la nutrition de quelques euglènes. II. *Euglena stellata, Klebsii, anabœna, deses* et *pisciformis*. Discussion et conclusions générales," *Ann. Inst. Pasteur*, 1933, **50**, 840). A study of the conditions of nutrition under which the species of *Euglena* named in the title are capable of living. The reaction at which the optimum development takes place in culture varies as follows : *E. gracilis, pH* 3–8·5 ; *E. stellata, pH* 5·5 ; *E. klebsii, pH* 6–7 ; *E. anabœna, pH* 6–8 ; *E. deses, pH* 6·5–7·5 ; *E. pisciformis, pH* 6·5–8·5. As regards the salts, it was found that generally the nitrates were less favourable than the ammonium salts. Only two species, *E. stellata* and *E. klebsii*, are capable of assimilating calcium nitrate. Ammonium nitrate, phosphate, and sulphate represent good sources of nitrogenous food for all of them. *E. anabœna* could be cultivated only in a medium containing ammonium phosphate. *E. deses* and *E. pisciformis* are unable to multiply in media in which the nitrogenous substances are represented either by a nitrate or by ammonium salt. The various requirements in amino-acids are recorded, *E. pisciformis* being the only species incapable of assimilating any amino-acids. In general, the peptones represent the most valuable sources of nutrition for *Euglena*. Each species thus has its peculiar requirements which can be utilized for their differentiation. C. A. H.

Effects of Conjugation in Paramæcium.—T. M. SONNEBORN and R. S. LYNCH (" Racial Differences in the Early Physiological Effects of Conjugation in *Paramecium aurelia*," *Biol. Bull.*, 1932, **62**, 258). Description of the results of experiments on the effects of conjugation in different lines of descent within a single species, worked out in *Paramœcium aurelia*. Individual ciliates were culti-

vated in isolation, one paramæcium to one drop of culture fluid in hollow-ground slides. In the course of the investigation sixteen different sets of conjugants and their descendants were studied. It was found that conjugation increases fission rate, variation, and mortality in some clones, but not in others. The physiological effects of conjugation are not the same in all clones of even a single species, but depend on the constitution of the individuals which conjugate. The diverse effects of conjugation characteristic of different clones of *P. aurelia* explain the disagreement in results and theories of previous authors, which may have been due to failure to examine the effects of conjugation in a sufficient number of different races within one species.   C. A. H.

Variation in Paramæcium.—D. RAFFEL ('Inherited Variation arising during Vegetative Reproduction in *Paramecium aurelia*," *Biol. Bull.*, 1932, **62**, 244). Study of a clone of *Paramæcium aurelia* started from a single individual and maintained in a culture medium of the following composition : KNO_3, 0·5 gm. ; K_2HPO_4, 0·06 gm. ; $MgSO_4.7H_2O$, 0·02 gm. ; $FeCl_3$, 0·001 gm. ; H_2O, 1 litre. To this solution cultures of an alga, *Stichococcus bacillaris*, and a bacterium, *Achromobacter candicans*, were added. The clone produced branches which differed from the original clone in larger size, form, greater rate of production, and diminished resistance to unfavourable conditions. These characteristics were consistently manifested by the branches, none of which reverted to the original type. It is concluded that the variation is produced by mutation of one member of the four or five heterozygous pairs of genes which are necessary to produce the normal type of this clone.   C. A. H.

Fibrillar System of Paramæcium.—E. E. LUND ("A Correlation of the Silver-line and Neuromotor Systems of *Paramecium*," *Univ. California Publ. Zool.*, 1933, **39**, 35, 6 pls.). A comparative study of the silver-line system and of the neuromotor system of *Paramæcium multimicronucleata*. These structures were examined in total preparations and in sections of the ciliates. In the former case the material was fixed in Zenker's fluid and stained with Delafield's, Heidenhain's, or Ehrlich's hæmatoxylins, or fixed in Schaudinn's fluid and stained with Heidenhain's hæmatoxylin. The ciliates were also treated by various silver methods. Material for sections was fixed in Zenker's and stained in Mallory's triple connective tissue stain, or treated with Schaudinn's fluid and Heidenhain's hæmatoxylin. The silver-line system is composed of two distinct parts : (1) The conductile system composed of closely set polygons (chiefly hexagons) and the trichocyst granules ; (2) the basal granules and the longitudinal body fibrils. The neuromotor system is also composed of two divisions : (i) a subpellicular part, consisting of the basal granules and the longitudinal body fibrils, and some other fibrils, and (ii) a part associated with the cytopharynx and gullet, comprising the pharyngo-œsophageal network, neuromotorium, penniculus, œsophageal process, para-œsophageal fibrils, posterior neuromotor chain, and post-œsophageal fibrils. All these parts are figured and their functions described. Arguments are brought forward for regarding the neuromotor system as having primarily. a conductile function. The use of the term "neuromotor system" when referring collectively to the conductile elements of the ciliates is suggested.   C. A. H.

New Human Intestinal Flagellate.—C. RODRIGUEZ LÓPEZ-NEYRA and E. SUÁREZ PEREGRIN ("El *Chilomastix granatensis*, nuevo flagelado parásito del intestino humano," *Bol. Soc. Españ. Hist. Nat.*, 1932, **32**, 489, 1 pl.). In the stools of three human cases of diarrhœa observed in Granada (Spain) the author found a *Chilomastix* which he regards as distinct from *C. mesnili* and for which he creates

a new species, *C. granatensis* n.sp. This parasite is characterized as follows : Body piriform, measuring 14–21μ in length and 9·5–14·5μ in breadth (average, 18 × 12·5μ) ; ratio of length to width : 1·4–2·0 (average, 1·5μ), as compared to 2·2–3·2 in *C. mesnili ;* anterior extremity rounded, posterior drawn out into a short process. Nucleus situated farther from edge of the body and richer in chromatin than in *C. mesnili ;* there is a central karyosome connected with the peripheral chromatin granules by linin strands. Cytostome, measuring 7–9μ in length and 2–4·5μ in breadth, begins at the side of the nucleus ; it is provided with strong lips raised to about 1·25–2μ and bordered by an undulating ridge. The lips unite anteriorly, enclosing three blepharoplasts : the central one gives rise to the cytostomal flagellum, the left one to a chromatic filament running along the base of this side to the posterior end of the cytostome where it turns round and passes to the right side ; the side blepharoplast is the starting point of a similar filament which runs along this side as far as the terminal portion of the left filament. Three other blepharoplasts, lying anterior to the nucleus and to the preceding group of blepharoplasts, give rise to the three free flagella, one of which is longer than the two others. The parasite in question thus differs from *C. mesnili* in larger dimensions, richness of nucleus in chromatin, and shortness of caudal process. A description is given of the division and encystment of this flagellate. The following technique was used in this investigation : the fæces were mixed with an equal volume of serum (human or equine), smears were made on slides and fixed in methyl alcohol ; they were then stained in the usual Giemsa solution for 35 minutes, after which they were differentiated in a mixture of 1 part acetone and 3 parts water, dehydrated in acetone, dried and examined without a cover-slip. [All the points in which the above parasite is said to differ from *C. mesnili* can easily be accounted for by the technique employed : the drying process causes the flagellate to flatten, while the stain is heavily precipitated in the nucleus ; the result is an apparent increase in the general dimensions of the body and of the chromatin granules in the nucleus. Moreover the length of the new parasite is not beyond the range previously recorded for *C. mesnili*.]   C. A. H.

Ciliates from Chinese Frog.—D. Nie (" On some Intestinal Ciliates from *Rana limnocharis* Gravenhorst," *Contr. Biol. Lab. Sci. Soc. China* (Zool. Ser.), 1932, **8**, 183). Description of infusoria from the large intestine and rectum of *Rana limnocharis*, collected in China. The parasites were studied in fresh material and after fixation in corrosive sublimate mixtures and staining with Heidenhain's or Delafield's hæmatoxylins. The following new forms are described in detail and illustrated : *Protoopalina limnocharis* sp.n., *Opalina undulata* sp.n., *O. acuminata* sp.n., *Nyctotherus nankingensis* sp.n., *N. pyriformis* sp.n. Other forms found in the same host were *Cepedea longa*, *Balantidium helenœ*, and *Nyctotherus cordiformis*.
    C. A. H.

New Hæmogregarines from Indian Tortoises.—F. DE MELLO (" Contributions à l'étude des hémogrégarinides des tortues indiennes. I. *Hœmogregarina malabarica* n.sp. et son cycle évolutif chez *Emyda granosa*, subspecies *vittata* Peters," *Arq. Escola Méd. Cirurg. Nova Goa* (Ser. A), 1932, Fasc., 8, 1411, 2 pls. ; " II. Sur une hémogrégarine parasite de *Emyda granosa* Schoepf.," *ibid.*, 1426, 1 pl.). Description of two new species of hæmogregarines parasitic in the blood of Indian tortoises, *Emyda granosa* and its subspecies *vittata*. One, named *Hœmogregarina malabarica* sp.n., occurs in the subspecies and is characterized by two types of schizogony in the liver, producing large and small merozoites respectively. The other form, named *H. xavieri* sp.n., occurs in the type-species, *E. granosa ;* its

schizogony takes place both in the liver and lungs. There is a detailed description of all stages of development, illustrated by figures in plates. C. A. H.

Growth of Gregarines.—S. F. BUSH (" Relative Growth of Gregarines : a Statistical Study," *Ann. Natal Mus.*, 1933, **7**, 195). Description of the results of a study, by statistical methods, of the relative growth of the different parts of the body of two species of gregarines—*Actinocephalus amphoriformis* (411 sporonts) from the grasshopper, *Rudonia chloronata*, and *Gregarinoides locustanæ* (155 primites and 147 satellites) from the locust, *Locustana pardalina*, captured in South Africa. Measurements were made of the following elements : length and width of protomerite and deutomerite, total length of sporont. The total length of sporonts of *Actinocephalus* ranged from 260μ to 953μ, that of the primites of *Gregarinoides* from 309μ to 569μ, and of the satellites from 337μ to 747μ. In both species the body is not growing at a uniform rate, but the protomerite grows relatively more slowly than the deutomerite, so that the ratio of protomerite to deutomerite is constantly decreasing, and is a function of the absolute size of the sporont. The width of the protomerite increases more rapidly than the length, so that it tends to become progressively shorter and stouter. The paper is illustrated by a series of graphs, tables, and mathematical formulæ. C. A. H.

Trichomonad Flagellates from Indian Termite.—F. DE MELLO (" On the Nature and Identification of some Small Trichomonads from the Intestine of Termites hitherto Related to So-called *Trimitus* Stages of Duboscq and Grassé," *Arq. Escola Med. Cirurg. Nova Goa* (Ser. A), 1932, Fasc., **8**, 1432, 1 pl.). Duboscq and Grassé found small flagellates, so-called *Trimitus* forms, in the intestine of termites, which they regarded as development stages of *Devescovina*, *Janickiella*, and *Trichomonas ;* on the other hand, Kirby created for these forms the genus *Tricercomitus*. The present author discovered similar *Trimitus* forms, associated with *Devescovina* and *Calonympha*, in the intestine of the Indian termite *Coptotermes heimi*. He accepts Kirby's interpretation, and identifies these flagellates with *Tricercomitus divergans*. C. A. H.

A Pseudoparasite from a Mite.—G. BOURNE (" A New Protozoan Parasite from a Bdellid Mite," *Papers and Proc. Roy. Soc. Tasmania*, 1933, **1932**, 10, 1 fig.). In the abdominal cavity of a Bdellid mite (*Biscirus intermedius*) from Tasmania, the author discovered a reniform body, about one-eighth the length of the animal. Neither by staining nor by dissection could any structure, except a general granular appearance, be made out. After the possibility of the body being the mite's egg, an ingested object, or a nematode egg were all considered and excluded, the author arrives at the rather sudden conclusion that " the parasite described above does not appear to be represented in the literature, but is obviously Protozoan in nature, a member of the Sporozoa." The author hesitates to define the exact systematic position of his " parasite," but places it " tentatively in the *Haplosporidia*." He feels, however, " that it will eventually require a new order of the Sporozoa to receive it." C. A. H.

Earliest Structure in the Textularidæ.—E. LACROIX (" Le pseudo morphisme chez les *Textularidæ*," *Bull. L'Inst. Ocean. Monaco*, 1933, no. 622, 1–12, text-figs. 1–10). Examination of the earliest series of chambers in carefully decalcified specimens of *Bigenerina nodosaria* d'Orbigny, and *Textularia concava* (Karrer), var. *heterostoma* Fornasini, discloses the presence of an unpaired chamber overlying or between the proloculum and the typical biserial growth. This unpaired chamber is found in both the megalospheric and the microspheric forms of

these species. The author discusses at length the significance of this early unpaired chamber which gives a distinctly triserial aspect to the initial portion of the shell. The question arises whether it is a vestige of the planospire which has been so frequently observed in the microspheric form B in the Textularidæ, and which may exceptionally occur in the megalospheric form A. He concludes that while it may be taken as proved that the earliest structure is triserial in the two species studied, it would be premature to take this triserial structure as definite evidence of the course of evolution in the Textularidæ, although it seems probable that the family, as at present constituted, will in the future require rearrangement. It seems unfortunate to the abstractor that the letters A, B, which have a definite and generally accepted significance as indicating the megalospheric and micro-spheric forms of Foraminifera, should in the text-figures be used indiscriminately for either form.   A. E.

Miogypsina in Mexico.—W. L. F. NUTTALL (" Two Species of *Miogypsina* from the Oligocene of Mexico," *J. Palaeont.*, 1933, 7, no. 2, 175–7, pl. 24). Two species of *Miogypsina* are described and figured from the Oligocene of the Tampico embayment of Mexico, where each has a restricted stratigraphical range. One of them, *M. mexicana*, is a new species stated to be quite distinct from the seven other species of the genus hitherto recorded from America. It is found in beds regarded as of Lower Oligocene age, associated with a foraminiferal fauna con-taining many Alazan (Lower Oligocene) species. The second species, *M. com-planata* Schlumberger, is a peculiar coiled form, interesting as the first coiled type of the genus described from America. Its occurrence is restricted to the Middle Oligocene (Meson) formation in the State of Vera Cruz, and the specimens appear to be identical with those originally described by Schlumberger from the Aqui-tanian (Miocene) of France, and recorded by Silvestri as rare in the Oligocene of Italy. In Mexico it is found associated with *Lepidocyclina gigas* Cushman and *L. undosa* Cushman.   A. E.

Foraminifera as Zone Markers.—W. L. F. NUTTALL (" The Application of Micro-Palæontology to Petroleum Geology," *World Petroleum Congress organized by the Institution of Petroleum Technologists, London, July,* 1933. *Preprint* no. 28, 1–6, chart). This paper, which we hope will be published in some more accessible form, discusses the use of the smaller Foraminifera in stratigraphical correlation. Their abundance in certain Tertiary deposits, together with the limited vertical distribution of many species, favour their use in problems related to petroleum geology. As a basis for correlation in a given area, it is important that a reliable type section be sampled at regular intervals, and studied in detail. The technique in the preparation of samples is discussed and a slide suitable for mounting Fora-minifera permanently is described, also standard methods of recording the occur-rence and frequency of species. It is frankly emphasized that the petroleum micropalæontologist has no use for the broad interpretations of species which satisfy zoologists, who regard minor differences as due to variations of no diagnostic value. For the successful application of micropalæontology in stratigraphy a very narrow definition is necessary, and the palæontologist seeks for constant varietal differences of stratigraphical significance. The conditions affecting the distribu-tion of Foraminifera are described, and attention drawn to the influence of environment on the nature of micro-fauna, in particular with regard to geological correlation and the faunal changes which may occur both laterally and vertically. Thus it may occur that the deposits in the upper part of a local sequence were laid down in brackish water, while in the lower part the water was more saline. Corresponding to the salinity there is a difference in the micro-fauna of the two

horizons. Similar differences due to the same causes may occur horizontally or laterally in strata of the same age, in particular as the shore of the basin of deposition approaches or recedes. For these reasons each basin of deposition must be studied as a separate problem. As an example of the use of Foraminifera in stratigraphy there is an elaborate table showing the distribution of 231 (palæontological) species in the Tampico Embayment, Mexico, in strata ranging between the Upper Cretaceous and the Lower Miocene. Altogether a very interesting paper and of value to all students of the Foraminifera, whether concerned with petroleum geology or not.   A. E.

Miocene Foraminifera.—J. A. CUSHMAN and E. D. CAHILL ("Miocene Foraminifera of the Coastal Plain of the Eastern United States," *U.S. Geological Survey. Professional Paper* 175—*A. Shorter Contributions to General Geology*, 1933, 1–50, pls. 1–13, table). Describes 134 species or varieties of Foraminifera found in the Miocene of the Coastal Plain region of the Eastern United States from Florida to Maryland. Two of the species or varieties have a range extending back to the Jurassic, seven to the Upper Cretaceous, fifteen to the Eocene, and eleven to the Oligocene. Four are known to have lived on into the Pliocene, one into the Pleistocene, and seventy-nine are still living in adjacent seas. In fact the Miocene Foraminifera are definitely related to the present-day fauna off the same shores, though there are numerous forms specifically distinct from living allied species now found off the same coasts. A few species are of special interest, as representing American forms closely related to Miocene species hitherto known only from Central Europe. Six species are described as new to science. The paper is admirably illustrated.   A. E.

A New Genus from the Middle Eocene.—J. A. CUSHMAN and G. M. PONTON ("A New Genus of the Foraminifera, *Gunteria*, from the Middle Eocene of Florida," *Cont. Cush. Lab. For. Res.*, 1933, no. 129, 25–30, pl. iii, figs. 1–3). The genus *Gunteria* is based on a single species, *G. floridana*, which is the principal constituent of a narrow zone of hard limestone believed to be of Middle Eocene age, and so far appears to be confined to this particular zone. Specimens attain nearly 7 mm. in diameter. The authors regard it as a development of *Dictyoconus*, in which the early stages show the conical test of that genus, but in the adult the whole later test is greatly compressed in one plane. The apertural face, instead of being circular or elliptical, becomes a narrow band extending in a semicircle about the periphery, usually with two nearly parallel rows of apertures. The subdivision of the cortical layer into fine chamberlets in the adult is similar to that of *Dictyoconus*. The figures, though good, are scarcely adequate for the illustration of the complicated structure of the genus. A few photographs of thin sections in various planes seem desirable.   A. E.

An Unnecessary Genus.—K. W. CARMAN ("*Dentostomina*, a New Genus of the Miliolidae," *Cont. Cush. Lab. For. Res.*, 1933, no. 131, 31–2, pl. 3, fig. 6). *Dentostomina* is based on the species *Quinqueloculina enoplostoma* d'Orbigny, described from Cuba in 1839, which is merely one of the many varieties of *Q. agglutinans* d'Orbigny, figured on the same plate of the Cuban monograph. *Q. enoplostoma* was distinguished by a row of small teeth surrounding the inner edge of the aperture, and d'Orbigny gives a magnified figure of these. The fact that they are not shown in the apertural view of the species, and that similar teeth *are* shown in the apertural view of *Q. agglutinans* without comment, indicates how little value d'Orbigny attributed to the feature. As a matter of fact similar corrugations or obstructions are frequently to be met with in Milioline apertures;

they represent a compromise between a large aperture giving rapid evacuation of the protoplasm for feeding purposes, and the need to restrict the aperture against small organisms which feed on protoplasm. The " genoholotype " is stated to be *Dentostomina bermudiana*, common in shallow water at Bermuda, and attaining a length of 3 mm. Of all the new genera created of late years this seems to be the least called for, and presenting the smallest chance of survival. A. E.

A Flush of New Genera.—J. A. CUSHMAN (" Some New Foraminiferal Genera," *Cont. Cush. Lab. For. Res.*, 1933, no. 132, 32–8, pl. iii, figs. 4–5, 7–12, pl. iv.). The fact that the author is about to publish a revised edition of his book on the Foraminifera is no doubt responsible for this addition of thirteen new genera to what is already an overwhelming list. They are mostly based on species which do not fit too happily into the genera assigned to them by their original authors. *Ammospirata* is based on *Pavonina mexicana* Cushman; *Ammomassilina* on *Massilina alveoliniformis* Millett; *Wiesnerella* on *Planispirina auriculata* Egger; *Sinzowella* on *Nubecularia novorossica* var. *deformis* Karrer and Sinzow; *Eggerella* on *Verneuilina bradyi* Cushman; *Goësella* on *Clavulina rotundata* Cushman; *Karreriella* on *Gaudryina siphonella* Reuss; *Listerella* on *Clavulina primaeva* Cushman; *Marssonella* on *Gaudryina oxycona* Reuss; *Liebusella* on *Lituola soldanii* Jones & Parker; *Martinottiella* on *Clavulina communis* d'Orbigny; *Valvulammina* on *Valvulina globulosa* d'Orbigny. The last of the thirteen novelties is *Gümbelitria*, genotype *G. cretacea*, a small but widely distributed Cretaceous fossil, which is stated to be similar to *Gümbelina*, but triserial. A. E.

Notes on the Valvulinidæ.—J. A. CUSHMAN (" Relationships and Geologic Distribution of the Genera of the Valvulinidæ," *Cont. Cush. Lab. For. Res.*, 1933, no. 133, 38–44, table). This is an important paper which defies abstraction within reasonable limits. It represents the author's views on the structure and evolution of the twenty-six genera which he groups together in the family, and must be studied in connection with specimens, or the literature of the genotypes. A. E.

Ultramicroscopic Viruses.

Cultivation of Louping-ill Virus.—T. M. RIVERS and S. M. WARD (*Proc. Soc. Exp. Biol. and Med.*, 1933, **30**, 1330–1). The virus of louping ill was successfully cultivated in two types of media. The first consisted of 0·1 gm. of minced chick embryo (11 days) brain suspended in a mixture (4·5 c.c.) of monkey serum (1 part) and Tyrode's solution (9 parts). The second medium was prepared in a manner similar to that of the first, with the exception that chick embryos from which the brains had been removed were used. G. M. F.

The Cultivation of Fowl Plague in the presence of Non-proliferating Cells.—H. PLOTZ and B. EPHRUSSI (" La culture de la peste aviaire en présence de cellules vivantes non proliférantes," *Compt. rend. Soc. de Biol.*, 1933, **113**, 711–12). Chick embryo tissue suspended in Drew's liquid is said to cease active mitosis on the third day after incubation at 37° C., nevertheless fowl plague virus can be grown in this medium when it has remained 5 days in the incubator. It is therefore concluded that actively proliferating cells are not essential to the growth of fowl plague. [Since the amount of chick embryo tissue necessary to ensure growth of viruses is very small, it is impossible to be sure that a few cells are not still proliferating.] G. M. F.

The Size of the Virus of Rift Valley Fever.—J. C. BROOM and G. M. FINDLAY (" The Filtration of Rift Valley Fever through Graded Collodion Membranes," *Brit. J. Exp. Path.*, 1933, **14**, 179–81). Rift Valley fever virus is from 23$\mu\mu$ to 35$\mu\mu$ in size. G. M. F.

The Size of the Virus of Borna Disease.—W. J. ELFORD and I. A. GALLOWAY and J. E. BARNARD (" Filtration of the Virus of Borna Disease through Graded Collodion Membranes," *Brit. J. Exp. Path.*, 1933, **14**, 196–206, 1 pl.). The virus of Borna disease is estimated to be from 0·085μ to 0·125μ. Bodies of fairly constant size have been obtained from infective filtrates by ultra-violet photomicrography. G. M. F.

The Cultivation of the Virus of Rift Valley Fever.—R. D. MACKENZIE (*J. Path. and Bact.*, 1933, **37**, 75–80). Rift Valley fever virus has been cultivated thirteen times consecutively, without loss of titre, in a medium of chick embryo and Tyrode's solution. The character of the virus appears to have remained unaltered during this procedure. G. M. F.

Canary Pox.—F. M. BURNET (" A Virus Disease of the Canary of the Fowl-pox Group : with a Note on the Microscopy by J. E. BARNARD," *J. Path. and Bact.*, 1933, **37**, 107–22, 2 pls.). The disease of canaries described by Kikuth and Gollub (*Zentrabl. f. Bakt. I, Ong.* 1932, **125**, 313) is caused by a virus closely resembling certain fowl-pox strains. The main histological features of the disease are pro-liferation of the dermal epithelium with cytoplasmic inclusions ; inflammatory response of predominantly mononuclear cells showing a characteristic vacuolation of the cytoplasm and massive accumulation of large mononuclear cells containing specific cytoplasmic inclusions in the infected lung. The virus produces massive lesions when inoculated on to the chorioallantoic membrane of the developing egg. By filtration and microphotographic methods the diameter of the virus particles is estimated to be about 0·16μ. The disease is uniformly pathogenic to canaries and sparrows ; in fowls only an insignificant lesion is produced, but in the pigeon a more definite transmissible inflammatory condition is caused ; in neither of these species are epithelial inclusions produced. Of three fowl-pox strains tested one caused lesions in the canary similar to those produced by Kikuth's virus. G. M. F.

The Attempted Production of Acute Disseminated Encephalomyelitis in Monkeys.—T. M. RIVERS, D. H. SPRUNT and G. P. BERRY (" Observations on Attempts to Produce Acute Disseminated Encephalomyelitis in Monkeys," *J. Exp. Med.*, 1933, **58**, 39–54, 3 pls.). No evidence was found to support the idea that vaccine virus placed in the cisterna magna is capable of producing an acute dis-seminated encephalomyelitis with perivascular demyelination either in normal or in partially immune monkeys. Repeated intramuscular injections of brain extracts and brain emulsions into eight monkeys were followed in two instances by an inflammatory reaction, accompanied by demyelination, in the central nervous system. The exact relation of the injections to the disease of the nervous system is not clear. The combined action of vaccine virus and an emulsion of fresh rabbit brain did not lead to an acute disseminated encephalomyelitis in monkeys that had received repeated intramuscular injections of emulsions and alcohol-ether extracts of normal rabbit brains. G. M. F.

The Cultivation of Filterable Viruses.—G. H. EAGLES (" The *in vitro* Cultivation of Filterable Viruses," *Biol. Rev.*, 1933, **8**, 335–44). In this review the

conditions necessary for the cultivation of filterable viruses are discussed with special reference to the growth of vaccinia virus. The possibilities of growing this virus in the absence of living cells are described. G. M. F.

The Rapid Cultivation of Fowl Plague.—H. PLOTZ ("Culture rapide du virus de la peste aviaire," *Compt. rend. Soc. de Biol.*, 1933, **113**, 570). The virus of fowl plague multiplies fifty times in the first 24 hours of tissue culture, a hundred times in the second 24 hours. By subculturing at 24-hour intervals it is thus possible to obtain very rapid constant multiplication. G. M. F.

The Effect of High Pressures on Bacteriophages and Vaccinia Virus.— I. BASSET, E. WOLLMANN, M. A. MACHEBŒUF and M. BARDACH ("Études sur les effets biologiques des ultra-pressions : action des pressions très élevées sur les bacteriophages et sur un virus invisible (virus vaccinal)," *Compt. rend. Acad. Sci.*, 1933, **196**, 1138–9). Staphylococcus bacteriophage is killed by exposure to 3000 atmospheres for 45 minutes, *B. typhosus* and *B. subtilis* bacteriophage by 7000 atmospheres, and vaccinia virus by 4500 atmospheres. Enzymes such as diastase and bacterial toxins are only destroyed by 10,000 atmospheres. G. M. F.

BOTANY.

Anatomy and Morphology.

Wood Structure of the Magnoliales.—R. P. McLAUGHLIN ("Systematic Anatomy of the Woods of the Magnoliales," *Trop. Woods*, 1933, **34**, 3–39). From a consideration of the anatomical structure of the woods of the Magnoliales, as proposed by Hutchinson, the following changes are suggested in order to bring about a more natural classification of the members of the group : (1) That the monotypic family, Himantandraceæ, be transferred to the Anonales. (2) That the monotypic family, Lactoridaceæ, be transferred to the Piperales. (3) That *Illicium* be segregated from the Winteraceæ and made the type of a monotypic family. (4) That *Euptelea* be segregated from Trochodendraceæ and made the type of a monotypic family as suggested by Van Tieghem. (5) That *Tetracentron* be made the type of a monotypic family. (6) That *Cercidiphyllum, Euptelea,* and *Illicium* be transferred from the Magnoliales to the Hamamelidales. (7) That Winteraceæ, Trochodendraceæ, and *Tetracentron* be differentiated from the Magnoliales (*sens. strict.*) and designated, if not as a distinct order, at least as a sub-order. (8) That the two remaining families, Magnoliaceæ and Schizandraceæ, which form a natural group both morphologically and anatomically, be retained as the order Magnoliales. The wood structure of all the genera in the order is described and an artificial key is given to their identification based on the anatomy of the woods. B. J. R.

Wood Structure of Daniella Oliveri.—F. DUCHESNE ("La Structure du bois de l'Arbre à Vernis," *Rev. Zool. Bot. Afr.*, 1932, **23**, 46–51, 2 pls.). Growth rings not apparent. Vessels 5–10 per sq. mm., single or in groups of 2–4 in association with 1–4 tracheids. Vessels 75–310µ in diameter, average 190µ. Vessel wall thickness 4·5–9·5µ. Vessel perforations simple ; segments 205–405µ in length, average 360µ. Intervascular pits opposite, irregular in outline, with horizontal apertures. Wood-parenchyma forms the bulk of the ground tissue, in concentric bands enclosing the vessels. Parenchyma cells in strands of 2 or 3 cells, storeyed. Secretory canals occur in the parenchyma tissue, single or in concentric lines separated only by the rays. Fibres in zones alternating with the parenchyma tissue ; storeyed : 335–385µ long ; pits not observed. Rays storeyed, 3 storeys per mm. ; of two types : (*a*) homogeneous, uniseriate, up to 8 cells high ; (*b*) heterogeneous, 2–4 cells wide, 7–13 cells high. B. J. R.

The Mechanical Strength of Ash Wood.—S. H. CLARKE ("On Estimating the Mechanical Strength of the Wood of Ash, *Fraxinus excelsior* L.," *Forestry*, 1933, **7**, 26–31, 2 figs., 1 pl.). Examination of the anatomical structure and specific gravity of specimens of ash which had been tested for mechanical strength led to the following conclusions : (1) For any given specific gravity an increase in the proportion of summer-wood in the annual ring is accompanied by a decrease

in mechanical strength, which is ascribed to a decrease in the thickness of the walls of the summer-wood fibres. (2) For any given proportion of summer-wood in the annual ring, an increase in specific gravity is accompanied by an increase in mechanical strength, due to an increase in the thickness of the fibre-walls. These relations were employed to derive a method of estimating the mechanical strength by considering both the amount of wood substance present and its distribution, as measured by the specific gravity and the percentage of summer-wood respectively.

<div align="right">B. J. R.</div>

Perforated Ray Cells.—L. CHALK and M. M. CHATTAWAY (*Proc. Roy. Soc.*, B, 1933, **113**, 82–92, 7 figs.). The paper describes an unusual type of ray cell in the secondary wood of certain dicotyledonous species, the side walls being perforated and connecting two vertical series of vessel segments on opposite sides of a ray. The lateral walls of these cells are exactly similar to the end walls of vessel segments. At the point where the vessel crosses the ray the latter is usually one cell in width; the ray cell becomes slightly swollen, rather in the manner of an oil or mucilage cell, and resembles a very short vessel segment. From the position and shape of these cells it is clear that they are derived from ray initials and not from fusiform initials. The lateral walls of the cells bear scalariform perforations where the vessels have scalariform or mixed scalariform and simple perforations; where the vessel perforations are simple those of the ray cells are usually simple but may occasionally be scalariform. These cells have been observed in seventy-four species from seventeen families which are listed. The woods in which the phenomenon occurs are from widely separated families and exhibit an extensive range of structure, but the rays are always high and have uniseriate margins of many cells.

<div align="right">B. J. R.</div>

Multiperforate Plates in Wood Vessels.—L. CHALK (" Multiperforate Plates in Vessels, with Special Reference to the Bignoniaceæ," *Forestry*, 1933, **7**, 16–25, 3 figs., 2 pls.). The paper describes the multiperforate plates in the wood vessels of the Bignoniaceæ, and distinguishes two types. The *Cordia* type consists of a thin membrane pierced by a large number of closely spaced angular perforations so that the membrane or perforation plate has the appearance of a fine net. The perforation plate is usually nearly horizontal and the individual perforations are very regular in size and arrangement and never show any sign of coalescing to form larger perforations. The diameter of the perforations is very similar to that of the intervascular pits. The second type, designated the *Ovoxylon* type, has much larger perforations, usually between two and five times the diameter of the intervascular pits. They are usually rounded and more widely spaced than in the *Cordia* type. A list of the species in which multi-perforate plates have been observed includes thirteen species of the Bignoniaceæ, two species (at least) of the Boraginaceæ, four species of the Nyctaginaceæ and one of the Verbenaceæ.

<div align="right">B. J. R.</div>

Silica Content of Woods in Relation to Teredo Resistance.—J. W. GONGGRIJP and A. T. J. BIANCHI (" Gegevens betreffende een Onderzoek naar Nederlandsch-Indische Houtsoorten, welke tegen den Paalworm bestand zijn " and " Nadere gegevens omtrent de Aantasting van Nederlandsch-Indische Houtsoorten door Paalworm en andere in Zee- en Brakwater levende Dieren," *Mededeelingen v. h. Boschbouwproefstation*, Buitenzorg, 1932, **25**, 1–147, 80 figs.). The first of these two papers describes how the immunity of manburlak timber (*Eschweilera longipes* Miers) to *Teredo* attack was found to be due to the presence of silica particles in the wood. Experiments with other timbers, which microscopic

examination showed to possess silica particles, demonstrated that a certain content of silica, together with a certain degree of compactness of the wood, constitutes a better protection against *Teredo* than all other known protective agencies for timber. The silica particles occur in the form of grains or more or less oblong bodies in the cavity of special cells or fibres, and sometimes in the cell walls of tyloses. In order to observe the silica, microscopic preparations are first bleached and then mounted in water. A better mounting medium is clove oil and phenol or alternatively methyl ether of salicylic acid (synthetic oil of wintergreen). An investigation of 814 timbers of the Dutch East Indies showed silica excretions in 181 species. The second paper records the results of investigations carried out since the conclusion of Gonggrijp's work in 1925. Practical trials have shown that the following silica-containing timbers are of special value for marine construction : *Metrosideros vera* and *M. petiolata, Cotylelobium flavum, Slœtia elongata, Parinarium corymbosum, Parastemon urophyllos* amd *Madhuca* sp. The results of practical trials with teak, *Tectona grandis*, were somewhat conflicting ; possibly there is a relation between the variability of the timber in this respect and the varying silica content which the wood has been shown to possess. Of the timbers which do not contain silica the following deserve special mention : *Eusideroxylon Zwageri*, whose resistance to *Teredo* attack is probably due to the high content of poisonous extractives ; *Lumnitzera littorea*, and *Lagerstrœmia speciosa*. The tests on the last named species appeared to show that the sapwood is appreciably more resistant than the heartwood and further investigations on this point are indicated. **B. J. R.**

Anatomy of Sisal Leaves and Fibre.—S. G. BARKER ("Sisal. A Note on the Attributes of the Fibre and their Industrial Significance," *Empire Marketing Board Pamphlet*, no. 64, 1933, 1–74, 15 figs.). An account is given of the source, cultivation, extraction, and uses of Sisal fibre. An account of the anatomy of the leaves, with special reference to the fibro-vascular bundles, is included, and the structure of the fibres themselves is also dealt with. It is stated that Sisal is derived chiefly from two species of *Agave*—*A. fourcroydes* Lem. (*A. rigida* Miller var. *elongata* Jacobi) which is cultivated chiefly in Yucatan, and *A. sisalana* Perr. (*A. rigida* Miller var. *sisalana*) which is native of Central America, but is extensively cultivated in E. Africa. *A. cantala* Rox. is also cultivated to some extent in Java and India. A description is given in popular terms of the appearance of a transverse section of a leaf and the distribution of the bundles within it. It is stated that as the leaf becomes older the thickness of the lignin increases. Also, since lignification increases with the age of the plant, it follows that fibres from young leaves on an old plant are more lignified than those from leaves of a corresponding age from younger plants. Short fibres, which are most abundant in young leaves are less lignified than long ones. It is stated that Sisal and Manilla fibres can be distinguished from one another by the crescent shaped fibre-groups seen in a transverse section of Sisal as opposed to the approximately circular groups in Manilla. " An approximate estimation of the percentage of the two fibres in a mixture may be achieved by cutting sections of equal thickness from a large number of mixed fibres, dividing them according to their contour into two groups which are then weighed." There are good microphotographs of transverse sections of the fibre groups.

C. R. M.

Morphology and Anatomy of the Phyllodes of Oxalis Herreræ R. Knuth and O. bupleurifolia St. Hil.—C. R. METCALFE (" A Note on the Structure of the Phyllodes of *Oxalis Herreræ* R. Knuth, and *O. bupleurifolia* St. Hil.," *Ann. Bot.*, 1933, 47, 355–9, 7 figs.). *Oxalis Herreræ* R. Knuth, a species from the Andes of Peru,

when growing in shady places bears normal leaves consisting of a slightly thickened petiole bearing leaflets. In more exposed situations, however, the leaflets having fallen off, the swollen petioles become the principal photosynthetic organs. Certain changes take place in the structure of the swollen petioles at the same time. The chief of these are : (1) The increase in size of the epidermal cells and thickening of the cuticle. (2) The increase in size of the chlorenchyma cells which are present immediately beneath the epidermis. (3) The stomata become more frequent. (4) The ground parenchyma cells, of which the petioles are chiefly composed. become greatly enlarged compared with those in petioles with leaflets still attached, Notes on the structure of the axis are given. *O. bupleurifolia* like *O. Herreræ* also has deciduous leaflets, but in this species the petiole is flattened, and presumably functions as the chief photosynthetic organ, especially after the leaflets have fallen. Towards the abaxial side the petiole is provided with fibro-vascular mixed with a few fibre bundles. On the adaxial side, however, the bundles are smaller and appear to consist entirely of fibres. It seems possible that these adaxial fibre bundles may represent reduced fibro-vascular ones in an originally radially symmetrical petiole.   C. R. M.

Causes of the Structural Changes undergone in Leaf Cuttings.— W. SCHWARZ ("Die Strukturanderungen sprossloser Blattstecklinge und ihre Ursachen. Ein Beitrag zur Kausalanalyse der Gewebebildung," *Jahrb. fur wiss. Bot.*, 1933, 78, 92–154, 27 figs.). In this paper an account is given of the structural changes and mode of production of new tissues which take place in leaf cuttings as these develop into new plants. Much of the subject-matter is purely physio-logical.   C. R. M.

Anatomy of the Leaves of Plantago.—GUSTAV OEHM ("Beitrag zur Kenntnis der Blattanatomie und Behaarung von *Plantago media* L., *Pl. major* L., und *Pl. lancelolata* L. mit besonderer Berücksichtigung der Unterscheidungs-möglichkeiten der Blatter auch in Bruchstucken," *Beih. bot. Centralb.*, 1932, 50, 20–43, 7 figs.). An account of an investigation carried out in order to discover anatomical features by means of which the leaves of the three common species of *Plantago* can be recognized even when in the form of small pieces. The principal gross morphological features of the leaves are also recorded towards the end of the paper. *P. lanceolata* can be recognized by its characteristic hairs, and in many cases by the one-sided mesophyll with sloping palisade cells. If the leaves are too finely powdered for these features to be readily observed, a reliable character is the more frequent occurrence of two bipolar subsidiary cells in association with the stomata of *P. lanceolata* than in the other two species. *P. media* and *P. major* can be distinguished from one another only with difficulty. However, this can be done by taking into consideration the distribution, shape, and length of the hairs, together with the characters of the subsidiary cells, the folds in the cuticle, and the sizes of the cells. The author does not appear to have taken into account the possible influence on the structure due to differences in the environmental conditions.
                                                                    C. R. M.

Abnormal Leaves of Ginkgo.—B. SAHNI ("On Some Abnormal Leaves of *Ginkgo*," *J. Ind. Bot. Soc.*, 1933, 12, 50–5, 4 figs.). An account of some funnel-shaped leaves of *Ginkgo biloba* collected from various sources. Details of the course of the bundles in them are described and illustrated. In one instance sections of a leaf having the form of one funnel within another are illustrated, but the mode of connection of the two funnels is not shown.   C. R. M.

Spodograms of Wheat Leaves.—HUZIO KATO (" Spodograms of the Leaves in Wheat," *Bull. Miyazaki Coll. Agric. and Forestry*, 1933, no. 5, 29–50, 48 figs. In Japanese. English Summary.) The author believes that different species of *Triticum* can be distinguished from one another by the anatomical characters to be observed in spodograms of their leaves. The characters found to be most useful for this purpose are the shape and size of the stomata, silica-containing cells, setiform hairs, and epidermal cells. A key to the following species is given in English : *T. vulgare, T. durum, T. monococcum, T. Spelta, T. dicoccum, T. polonicum, T. turgidum*, and *T. compactum*. C. R. M.

Adventitious Roots in Salvia Grahami Benth.—MARIA VENTURA (" Sulla origine delle radici avventizie nei rami di *Salvia Grahami* Benth.," *Annal. di Bot.*, 1933, **20**, 24–26, 1 pl.). Adventitious roots occurring on internodes of the stems of *Salvia Grahami* Benth. were found to originate from the interfascicular cambium of the stem. A. W. E.

Cambial Activity in the Catkins of some Early Flowering Catkin-bearing Dicotyledons.—N. GILL (" The Relation of Flowering and Cambial Activity. Observations on Vascular Differentiation and Dry-Weight Changes of some Early Flowering Catkin-bearing Dicotyledons," *New Phyt.*, 1933, **32**, 1–12). An account of some observations on *Populus serotina* Hartig, *Salix caprea* L., *Corylus Avellana* L., and *Alnus glutinosa* Gaert., made in order to determine whether, in these species, cambial activity begins in association with the opening of the inflorescence buds and thence proceeds basipetally downwards before cambial activity begins in the vegetative buds. Changes in the fresh and dry weights and ash content were also studied. It was found that in the axis of the male catkins of *Populus serotina* and *Salix caprea*, the catkins of which are enclosed in buds when spring activity begins, renewed differentiation of wood and phloëm begins when the catkins expand. Phloëm is produced throughout the twigs below the expanding catkins at the same time, but the production of wood does not begin in the twig beyond the region at which the catkin trace unites with the stele of the twig. Meanwhile the absolute dry weight of the tissues increases owing to the incorporation of organic matter withdrawn from the twigs. On the other hand in *Coyrlus Avellana* and *Alnus glutinosa*, whose catkins are exposed when spring activity begins, no renewed cambial activity occurs, and the absolute dry weight of the catkins during expansion shows no significant change. In these species expansion of the catkins is thought to be due to increase in the size of the existing cells as these absorb water. There is a discussion of the significance of the results obtained. C. R. M.

Structure of Tobacco Seed and Anatomy of the Seedling.—G. S. AVERY, JR. (" Structure and Germination of Tobacco Seed and the Developmental Anatomy of the Seedling Plant," *Amer. J. Bot.*, 1933, **20**, 309–27, 5 pages of figs.). The inner walls of the epidermal cells of the seed are thick, whilst the outer walls are thin. The reticulate appearance of the mature seed is due to the collapse of the thin outer walls. There are three layers of thin-walled parenchyma immediately beneath the epidermis, enclosing a single persistant layer of nucellar tissue. The hypocotyl grows in length as a result of the elongation of existing cells, as well as by the formation of new ones. No new cells are formed in a radial direction until secondary thickening begins. The transition region is usually about 2 mm. below the cotyledons and usually extends downwards only for a distance of 1mm. The internal phloëm is not differentiated until several days after all other primary tissues. The external phloëm usually gives rise to four internal phloëm strands, the first of which is differentiated inwards through a cotyledonary gap, whilst the remaining

three are differentiated at successively higher levels. When secondary thickening takes place, the external and internal phloëm groups are connected by phloëm parenchyma laid down by the cambium in association with the ray parenchyma. Growth of the cotyledons is at first basipetal. There is a well marked Casparian strip extending to well within the cotyledonary petiole. The lower epidermis serves to absorb food materials from the endosperm and therefore develops slightly later than the upper epidermis.   C. R. M.

Development of the Seed of Tulipa Gesneriana L.—V. BAMBACIONI-MEZZETTI (" Osservazioni morfologiche e micro-chimiche sui semi in via di sviluppo di *Tulipa Gesneriana* L.," *Annal. di Bot.*, 1933, **20**, 1–11, 1 pl.). In the seed of *Tulipa Gesneriana* L. a perisperm develops which is mainly chalazal. This is transitory in nature since it is completely digested by the albumen so that no trace of it remains in the mature seed. The carbohydrate reserves of the maturing seed consist of starch in the outer integument, and another substance intermediate between starch and cellulose in the perisperm. The latter substance, like starch, is secreted in the form of granules by plastids probably of mitochondrial origin. In the mature seed the carbohydrate reserves are represented by the walls of the cells of the endosperm and the protein reserves by the protoplasmic contents of the endosperm cells.   A. W. E.

Transition Region in the Seedling of Ricinus communis.—F. M. SCOTT and H. M. SHARSMITH (" The Transition Region in the Seedling of *Ricinus communis* : a Physiological Interpretation," *Amer. J. Bot.*, 1933, **20**, 176–87, 16 figs.). In the seedling of *Ricinus communis* lignification begins at four points on the inner margin of the procambial strand where the centripetal protoxylem strands are formed. " Increasing water absorption and the consequent upward conduction along this protoxylem serve to dilute and to divert to right and to left the downward stream of food materials." The authors believe this to be the cause of the subsequent lignification extending tangentially from the protoxylem. Later on, " as the food stream becomes relatively stabilized in its now interradial position, the foci of ligni-fication follow suit, and centrifugal metaxylem is now laid down." The authors were unable to decide definitely why there should be four initial centres of lignification.   C. R. M.

Development of the Fruit of Hordeum, Triticum, Bromus, and Poa with Special Reference to the Testa.—LUISE KRAUSS (" Ëntwicklungsgeschichte der Früchte von *Hordeum*, *Triticum*, *Bromus* und *Poa* mit besonderer Berück-sichtigung ihrer Samenschalen," *Jahrb. fur wiss. Bot.*, 1933, **77**, 733–808, 43 figs.). An account of the anatomy of the fruits of species of *Hordeum*, *Triticum*, *Bromus*, and *Poa*. Some attention was paid to the early stages in the development of the fruits, but the paper is concerned mainly with the cell layers of the testa. Stages of fertilization in awned varieties of barley were studied and found to agree closely with those previously described for *Triticum*. The pollen tube was found to pass through the tissues of the outer integument which are lost before the fruit is 4–5 mm. long. The ripe testa consists of two layers of cells of the inner integument. The thick outer and thin inner cuticles are developed solely from the inner integument. The aleurone layer is developed around the starchy endosperm and scutellum, whilst elsewhere it is converted to mucilaginous cells devoid of aleurone bodies. In the ripe seed the cell wall consists of strongly mucilaginous, pectin-containing cellulose. In unawned barley there was found to be a definite opening in the cuticle in the region of the micropyle, the testa elsewhere being surrounded by suberin and cork lamellæ. The author was able to confirm the

discovery previously made by Nilsson-Ehles (1914) and Zeuschners (1926) that the testa of wheat can be separated into two layers by treatment with concentrated sulphuric acid. However, the author differs from them in believing that the testa of wheat, like that of barley, is developed solely from two layers of cells of the inner integument, the outer integument becoming lost. The red colour of some varieties of wheat grain was found to be due to a corky substance laid down in the testa. From varieties with white grains this was absent or present in them only in small quantities. The testas of *Bromus erectus*, *Poa pratensis*, and *P. compressa* were also studied. The author was able to confirm Andersen's opinion that the testa in the two species of *Poa* examined is developed from the outer integument.

<div align="right">C. R. M.</div>

Histology of Crown-gall and Wound Callus on Apple.—E. P. SYL-WESTER and M. C. COUNTRYMAN ("A Comparative Histological Study of Crown-gall and Wound Callus on Apple," *Amer. J. Bot.*, 1933, **20**, 328–40, 7 figs., 2 pls.). An account of an investigation carried out in order to discover anatomical differences by means of which crown-galls on apple caused by pathogenic bacteria can be distinguished from similar non-pathogenic callus knots. It was found that both types of growth are very similar in structure, and are derived by proliferation of tissues external to the xylem cylinder. "Meristematic islands" having the form of spheres, whorls, cylinders, or sheets are present within the proliferated parenchymatous tissue, and give rise to stratified derivatives on the inside and parenchyma on the outside. The cells cut off on the inside develop into contorted xylem elements. Any particular "meristematic island" retains its activity only for about three weeks, but fresh "islands" are formed successively at the margin of the outgrowth. The gall enlarges by proliferation of the peripheral cells as well as by internal meristematic growth. The microchemical reactions of crown-gall and callus knot tissues were also found to be very similar to one another. However, tannin was found to be present in crown-gall, but not in callus knots. The only structural difference found between the two types of gall was that whereas crown-gall usually had a zone of dark, polygonal, close-fitting cells near the surface, graft callus has a periderm similar to that of the normal stem. C. R. M.

Stomata in Gymnosperm Seedlings.—D. PRIVAULT ("L'apparition des stomates sur les plantules de gymnospermes," *Ann. Sci. Nat.*, Sér. 10, 1933, **15**, 1–16, 2 pls.). The embryos of the ripe seeds of *Pinus Pinea* L., *Pseudolarix Kæmpferi* Gord. and *Ginkgo biloba* L. all show stomata in varying stages of development, although they are rare in *Pseudolarix*, probably owing to the small size of the embryo. This presence of stomata may be correlated with the remarkable development of the embryos which already contain the ground-work of the secretory canal system ; the embryos of *Pseudolarix* are, moreover, all coloured green by the presence of chlorophyll. In the course of growth the new stomata appear with a certain regularity in *Pinus Pinea* and *Pseudolarix Kæmpferi*, but in *Ginkgo* the irregular differentiation of the stomata makes it impossible to say whether new ones are formed in that part of the cotyledons which remains enclosed in the endosperm. Growth is marked by the lignification of the stomata and division of the accessory-cells. Culture in artificial medium of the embryos of *Pinus Pinea* has a notable effect on the formation of the stomata, many of which are aborted and reduced to a single cell. A. W. E.

Occurrence and Development of Calcium Oxalate in the Solanaceæ. —W. KREUSH (" Über Entwicklungsgesichte und Vorkommen des Kalziumoxalates in Solanaceen," *Beih. bot. Centralb.*, **50**, Abb. 1, 410–430, 5 figs., 1 pl.). An account

of the shape and mode of development of the various types of calcium oxalate crystals which occur in *Datura Stramonium, Capsicum annuum, Atropa Belladonna,* and *Hyoscyamus niger.* The development of the crystals is first dealt with in a general way, after which their form and distribution in different parts of young and old plants are described in turn for each of the above species. Brief notes on the distribution of crystals in *Discopodium penninervium* Hochst., *Iochroma tubulosa* Benth., *Hyoscyamus reticulatus* L., *H. physaloides* L., *Scopalia carniolica* Jacq., *Physoclœna orientalis* Don.; three species of *Solanum, Saracha viscosa* Schrad., *Solandra grandiflora* Sw., and *Juanulloa parasitica* Ruiz. & Pav. are also given. The crystals are not at first laid down in their final form, but appear as minute granules in the plasma. These collect together and develop into sphæro-crystals with a plasma membrane, which in turn develop into solitary crystals and give rise to the various forms of crystal and crystal sand. In ill-nourished plants the early and late stages in the development of crystals proceed normally, but some of the intermediate stages are omitted. Moreover, types of crystal, which in plants grown under normal conditions are found only in old tissues, were found to occur in tissues of all ages in ill-nourished plants. The author believes that the type of crystal to be deposited is determined by variations in the concentrations of the calcium and oxalate ions. The foliage leaves of *Datura Stramonium* have club-shaped cluster crystals (Morgensterndrusern) distributed throughout the tissues of the lamina except in the cells in direct communication with the vessels. In *Capsicum annuum,* solitary and cluster-crystals as well as crystal sand are present ; in *Atropa Belladonna* only crystal-sand ; in *Hyoscyamus niger* solitary crystals and crystal-sand in the xylem parenchyma. The cotyledons differ from ordinary foliage leaves in respect of their crystal content, and most frequently are provided only with solitary crystals. Young Solanaceous flowers are free from calcium oxalate, but deposits are formed in old ones. Calcium oxalate, when present in the ovary, disappears as the fruit ripens. In shoot and root, calcium oxalate is found usually only in the form of crystal sand, which is especially abundant in the bark and pith.   C. R. M.

Embryology of Periploca græca L.—PAOLA PARDI (" Embriologia della *Periploca græca* L.," *Nuov. Giorn. Bot. Ital.,* 1933, **40,** 141–166, 28 figs.). The anatropous ovules of *Periploca græca* L. are transnucellate and the nucellus is of syndermal type. As is general in the Asclepiadaceæ, with the exception of *Asclepias tuberosa,* there is a single mother-cell and the archesporium remains unicellular. Meiosis occurs regularly forming four megaspores arranged in a row. The female gametophyte is monosporial and eight-nucleate, and originates from the chalazal megaspore. In the normal mature gametophyte the synergidæ show no trace of filiform apparatus. The antipodals appear to be more or less developed, but their degeneration is always much later than that of the synergidæ, a fairly long time after fertilization. It is probable that their nuclei participate actively in the nutrition of the gametophyte. In the anthers differentiation is perfectly normal. The evolution of the tapetum follows the classical course described by Bonnet for the Angiosperms but lacks the second division of the nutritive cells. Microsporogenesis and fertilization are both normal and the endosperm is nucleate. The first divisions of the zygote are initiated about a month after fertilization. The embryo divides as in the Solanaceæ with the four primary blastomeres arranged in a linear series.   A. W. E.

Vacuoles in Primary Meristems.—CONWAY ZIRKLE (" Vacuoles in Primary Meristems," *Zeit. f. Zellforsch. u. mikr. Anat.,* 1932, **16,** 26–47, 4 pl., and in *Contr.*

Bot. Lab. Univ. Penns., 1932, **9**). Vacuoles in primary meristems of *Pinus*, *Polygonum*, *Robinia*, *Phaseolus*, *Fraxinus*, *Zea*, *Osmunda*, and *Lunularia* were investigated in both living and fixed preparations. The usual acid fixatives on the acid side of pH4·2 give an erroneous picture of the cytoplasm and vacuoles. Modified mitrochondrial fixatives preserve their true form although the vacuolar membranes are destroyed. Vacuoles containing tannin can be blackened with the Golgi techniques or treated with mixtures of formaldehyde and iron salts. Mixtures of $K_2Cr_2O_7$ and $(NH_4)_2\ Cr_2O_7$ with formaldehyde fix well but are unstable, and equally good results were obtained by fixing with formaldehyde and $Cr_2(SO_4)_3$ brought to pH4·6 with CuO. The normal spherical vacuoles of cells of the apical meristem may, on the initiation of cyclosis, change shape and even anastomose to form a reticulum. In general, vacuolar evolution in all the primary meristems investigated is for the large vacuoles of the apical cell to divide into smaller ones in the course of cell-division and then to enlarge again. Vacuoles reproduce by division of pre-existing vacuoles and in no case were they found to be derived from tonoplasts, hydroleucites, mitrochondria, etc. They were never observed to originate *de novo*, though in a streaming cell such formation might be obscured. A tannin-free core extends through the root-cap in *Pinus* and *Polygonum*, and possible traces of such were found in the root-tips in *Robina* and *Phaseolus*. This structure is absent in *Zea* and *Osmunda* although the latter has a tannin-filled root-cap. This core is so distinct as to suggest the performance of some specific function.　　　F. B.

Sieve-Tube Structure and Translocation in the Potato.—ALDEN S. CRAFTS ("Sieve-tube Structure and Translocation in the Potato," *Plant. Phys.*, 1933, **8**, 81–104, 1 fig., 6 pl.). Young sieve-tubes in the potato are normal living cells but as they mature the nuclei and slime bodies disintegrate and the protoplasm apparently changes, becoming still more permeable. Slime plugs are formed by the action of killing agents upon the vacuolar contents. Pores within the protoplasmic strands of the sieve-plates could not be demonstrated. Phloëm exudate has a low surface-tension, coagulates slowly, and emerges at a rate of flow that would account for normal translocation. It is indicated that a 10 p.c. sucrose solution would have to flow 19 cm. per hour through a conduit equal in transverse area to the total phloëm to provide for tuber formation. Sieve-tube lumina apparently afford the most available channels for this movement. The phloëm increases greatly in cross-sectional area within the tuber and the rate of flow is correspondingly reduced. Protoplasmic streaming may accelerate lateral movement across non-vascular tissues. A rate of $1·1\mu$ per hour for diffusion along plasmodesma of cross walls in the tuber is calculated. It is suggested that the conduction of organic nutrients in the potato takes place by diffusion along plasmodesma of cross-walls, accelerated by streaming within living cells combined with mass flow through vascular tissues.　　　F. B.

Ovule and Embryo-Sac of Saxifraga virginiensis.—MARJORIE CHAPMAN ("The Ovule and Embryo-Sac of *Saxifraga virginiensis*," *Amer. J. Bot.*, 1933, **20**, 151–8, 1 pl.). *Saxifraga virginiensis* deviates from the normal in its embryo-sac formation in that the four megaspores are arranged in a T-shaped formation. The inner of the four megaspores develops into the embryo-sac, the remainder rapidly disintegrating. No irregularities were noted in the formation of the eight nuclei of the embryo-sac. The small antipodals disintegrate early. The fusion of the polar nuclei produces an outstanding large fusion nucleus. The embryo-sac just before fertilization contains four nuclei—two synergids, and the egg-cell arranged normally and the fusion nucleus at or slightly above the middle. Five out of

sixty-seven flowers examined showed the occurrence of two embryo-sacs in the same ovule. The extra embryo-sac resulted from the division of a second megaspore mother-cell and not from a sister megaspore. F. B.

Identification of Species of Bean used in Meal Manufacture.—ALEXANDER NELSON and J. M. MUNRO (" The Identification of Various Species of Bean which may be used in the Manufacture of Meal," *Notes Roy. Gard. Edinb.*, 1933, 18, 7–12, 10 figs.). The identification of species of bean which have been ground to make a bean meal is described. Small pieces of seed-coat always present in such meals are sectioned transversely and examined microscopically. The following characters are seen : (1) Palisade cells comparatively large with cylindrical cavity—*Vicia Faba*. (2) Palisade cells comparatively small and with flask-shaped cavity : (a) no intercellular spaces in the second layer, the cells of which contain calcium oxalate crystals—*Phaseolus vulgaris* ; (b) intercellular spaces present in second layer, i.e. cells " hour-glass shaped " : (i) second layer irregular—*P. lunatus* ; (ii) second layer regular—*P. Mungo, P. calcaratus, P. angularis, P. aconitifolius.* F. B.

Contribution to the Systematics of the Genus Linum.—H. NESTLER (" Beitrage zur systematischen Kenntnis der Gattung *Linum*," *Beih. bot. Centralb.*, 1933, 50, 497–551, 4 pls., 103 figs.). The greater part of this paper gives information concerning the systematics of the genus *Linum* based on gross morphological features. However, general anatomical features of stems and petioles are also taken into account. These are fully illustrated with line drawings. C. R. M.

Application of Fluorescence Microscopy to Botany.—M. HAITINGER and L. LINSBAUER (" Die Grundlagen der Fluoresenzmikroskopie und ihre Anwendung in der Botanik," *Beih. bot. Centralb.*, 50, Abb. 1, 1933, 432–44). Many natural objects are fluorescent when examined in ultra-violet light, and furthermore the colour of the fluorescence is frequently distinctive for a particular object. This applies also to microscopical observations, but for studying objects in this way microscopically it is necessary to pay great attention to obtaining the correct conditions. Successful results can be obtained only with freshly made preparations in a suitable mounting medium. However, under correct conditions, the individual tissues of many botanical objects exhibit fluorescence colours characteristic for each type of tissue. The first part of the paper describes suitable apparatus and conditions to ensure success. In the authors' experiments illumination was effected by means of artificial light having a wave-length of 300–400 $\mu\mu$. All glass parts of the apparatus must be of a non-fluorescing material. However, even if the conditions are suitable many objects fail to show a distinctive fluorescence, e.g the xylem of many woody stems exhibits an apparently similar blue, and the epidermal cells of bulb scales, many roots, hairs, etc., show a very dull fluorescence. The authors found that in these instances it is possible to treat the objects to be studied with chemical substances which promote differentiation and intensification of the fluorescence characters of the individual tissues. These fluorescence-promoting substances are not true stains in the ordinary sense of the word, their effect is not permanent, and they are best used in very low concentrations. Tables are given showing details of the colours obtained and their duration when various fluorescence-promoting substances were used to treat : (1) a transverse section of a needle of *Pinus nigra* ; (2) the epidermis of a bulb scale of *Allium Cepa* ; (3) the cotyledons of various fat-containing seeds. The names of the various fluorescence-promoting substances are given. These, as well as suitable microscopical equipment and lamp, can be obtained from the firm of Reichert in Vienna. C. R. M.

CRYPTOGAMIA.

Pteridophyta.

Paradoxopteris.—W. N. EDWARDS (" On the Cretaceous Fern *Paradoxopteris* and Its Connection with *Weichselia,*" *Annals of Botany*, 1933, **47**, 317–41, 1 pl. and 2 figs.). A description of the anatomical structure of *Paradoxopteris*, a fossil fern from the Libyan Desert. It appears to be the rachis of the Lower Cretaceous fern fronds long known under the name of *Weichselia*. The morphology and anatomy of *Weichselia* are discussed, as also the affinities of these fossils. A. G.

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Fossil Megaspores.—ZOFJA KOWALEWSKA MASLANKIEWICZOWA ("Megaspory z pokladu Elzbieta (warstwy laziskie) w Sierszy " [" Megasporen aus dem Flötz Elzbieta in Siersza "], *Acta Soc. Bot. Poloniæ*, 1932, **9**, 155–74, 11 figs.). A study of megaspores found in the " Elizabeth " stratum of the Zbyszek mine at Siersza. This stratum corresponds stratigraphically to the Lazisch strata of Upper Silesia. The megaspores described can be referred to the various sub-groups of the collective main-group *Triletes* of Reinsch, which comprises all fossil spores that belong to Lepidodendraceæ and allied families. The sub-groups are distingished by the exospore characters. A. G.

Fern Prothallia.—WILHELM SCHMELZEISEN (" Beiträge zur Entwicklungs-geschichte der Prothallien einiger Marattiaceen, Cyatheaceen und Polypodiaceen," *Flora*, 1933, N.F. **27**, 46–80, 5 pls. and 5 figs.). An account of the cultivation of the prothallia of *Angiopteris*, *Alsophila*, and of some species of *Dryopteris*, *Doryopteris*, *Adiantum*, *Platycerium*, *Davallia*, *Woodsia*, with a description of the development and morphology of each. A. G.

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of the stomata cells, and the sporangium with oblique ring and with stalk of four cell rows. After a difficult search he discovered the gametophyte stage of the plant, and is able to describe and figure it in detail. The occurrence of Mycorrhiza in the thallus and the straightness of the archegonial neck confirm the view that the genus has no affinity with Polypodiaceæ. A. G.

Fertile Nerves of Ferns.—FRITZ SPRAU (" Untersuchungen über den Aufbau fertiler Nerven bei Farnen und die Verteilung der Baustoffe im fertilen Blatt.," *Beih. z. Bot. Centralb.*, 1933, **50**, Erste Abt. Heft. 2, 323–409, 85 figs.). The results of an investigation of the structural details of the fertile nerves of 130 different species of ferns, grouped as follows : (*a*) Leptosporangiatæ—(1) with sori, (2) with sporangia not in sori; (*b*) Eusporangiatæ with sporangia—(1) superficial, (2) immersed. A. G.

Bryophyta.

Haplomitrium and Fossombronia.—F. KOPPE (" Eine Moosgesellschaft des feuchten Sandes," *Ber. d. Deutsch. Bot. Ges.*, 1932, **50**, 502–16). *Haplomitrium Hookeri* and *Fossombronia incurva* are among the rarest of North German hepatics. A careful study of the conditions under which they occur shows that they require a fine to coarse rather acid sand, never completely desiccated, but during the summer months at least not too wet; and they must not be overgrown by other plants. The bryophytes and other plants which are more or less associated with these two species in such a situation are discussed. And a table is provided in which the constituent flora of twenty-two such localities in North Germany is analysed and displayed. A. G.

Japanese Hepaticæ.—YOSHIWO HORIKAWA (" Studies on the Hepaticæ of Japan. VIII," *J. Sci. Hiroshima University*, 1933, ser. B, Div. 2, Botany, **1**, 197–205, 1 pl., 4 figs.). Descriptions and figures of nine species of Japanese hepaticæ, eight of which are new to science. A. G.

Fossil Mosses.—RUDOLF WILCZEK (" Starodyluwjalne Mchy Walawy i Baryczy." [" Altdiluviale Moose von Walaw und Barycz "] *Acta Soc. Bot. Poloniæ*, 1932, **9**, 237–88). Descriptive notes of fifty species and ten varieties of pleistocene mosses from Walawa and Barycz, forming a completion of the author's survey of " Die altdiluvialen Dryasfloren der Gegend von Przemysl " (*tom. cit.* Heft. 1- 2). A. G.

Water Conduction in Mosses.—ESTHER J. BOWEN (" The Mechanism of Water Conduction in the Musci considered in Relation to Habitat," *Annals of Botany*, 1933, **47**, 401–22, 20 figs.). An account of the organization of five species of mosses that flourish in wet environments—*Brachythecium rutabulum, Philonotis fontana, Hypnum cuspidatum, Aulacomnium palustre, Campylopus brevipilus*— the first near waterfalls, the others in bogs. In each case the rate and amount of water conducted over the external surface and through the internal tissues was measured. The external morphology of the plant and the internal tissues of stem and leaf were carefully studied in relation to water conduction and absorption. In all cases the external capillary water conduction exceeded the internal current ; the latter travelled through the narrow, elongated, thin-walled cells of the central strand, figures of which are given. A. G.

Thallophyta.

Algæ.

Cyanophyceæ.—R. Kongisser (" Zur Kenntniss der Bewegung von einzelligen Cyanophyceen," *J. Botanique de l'U.R.S.S.*, 1932, **17**, 379–82). An account of the movements made by detached cells of *Glœothece linearis* in a culture of mud from Pijavotschnoe lake. The plant forms small blue-green colonies on the surface of the mud, and numerous single cells move about in the water. Their motions are not due to Brownian movement; they are fairly rapid and resemble those of *Synechococcus æruginosus* as described by Perfiliew. A. G.

Protococcales.—Bohuslav Fott (" Einige neue Protococcalenarten," *Beih. z. Bot. Centralbl.*, 1933, **50**, Zweite Abt., Heft 2, 577–84, 6 figs.). Descriptions and figures of some new plankton species of Protococcales—*Thorakochloris planktonica, Oocystis ornata, Lagerheimia minor*, and notes on other forms. A. G.

Dinobryon.—Fritz Gessner (" Die Gattung *Dinobryon* in phylogenetischer Betrachtung," *Ber. Deutsch. Bot. Gesellsch.*, 1933, **51**, 8–12, 1 pl.). A discussion of the chrysomonad *Dinobryon* and its affinities. A. G.

Index to Diatoms.—Frederick Wm. Mills (an Index to the Genera and Species of the Diatomaceæ and their synonyms, 1816–1932, 1933, **1**, Part I, 1–74; Part II, 75–148. Issued to subscribers by F. W. Mills, Milton Damerel, North Devon, and by Wheldon and Wesley, London). A multityped copy of the author's private reference catalogue compiled during many years. This index comprises more than 500 genera and probably 60,000 species and varieties, and over half a million references. The work is preceded by a bibliography of fifty pages. The two parts issued carry the index from *Acanthoceras* to *Amphora areolata*. A. G.

Protosiphon.—Harold C. Bold (" The Life History and Cytology of *Protosiphon botryoides*," *Bull. Torrey Bot. Club*, 1933, **60**, 241–99, 10 pls., 7 figs.). *Protosiphon botryoides* Klebs is a cosmopolitan which occurs on damp soil together with *Botrydium*, and before 1896 was included with it. It is a pyriform cœnocyte with a large vacuole and diffused chlorophyll. In water the plant produces zoospores which may grow directly into thalli, or may fuse in pairs forming a zygote, which after a period of rest germinates into a thallus. Under conditions of drought and strong sunlight the plant becomes segmented into a number of multinucleate cœnocysts, which on a moderately moist substratum can develop directly into a mature plant, or in water form zoospores which may grow into thalli or may fuse in pairs and form zygotes. These processes are all described in detail. As to its systematic position, *Protosiphon* along with *Halicystis* should be placed among the simpler Siphonales. A. G.

Oedocladium.—Edgar Knapp (" Ein neues *Oedocladium* aus Nord-Amerika (*Oed. Wettsteinii*)," *Ber. Deutsch. Bot. Gesellsch.*, 1933, **51**, 40–3 1 pl.). A new species of *Oedocladium*, concealed in the earth of a sample of *Sphærocarpus Donellii* received from Florida, was discovered by cultivation. The genus *Oedocladium* was created by Stahl in 1891 for an alga found near Strassburg. Three years ago three North American species were added. The plant now described and figured brings the total of species to five; four of these are terrestrial, and one aquatic. A key to the species is provided. A. G.

Indian Volvocales.—M. O. P. IYENGAR ("Contributions to Our Knowledge of the Colonial Volvocales of South India," *J. Linn. Soc. Bot.*, 1933, 49, 323–73, 1 pl., 10 figs.). Beginning with some general remarks on the occurrence of colonial Volvocales in Southern India, the author gives a systematic and detailed account of the species investigated, including *Chlamydobotrys stellata, Pandorina morum* (with a new form), *Eudorina elegans, E. illinoisensis, E. indica,* and *Pleodorina sphærica* (the latter two being new to science); also seven species of *Volvox,* among which are a new species and a new combination, three new varieties and a form. A chapter is added on the organisms observed upon or within species of *Pandorina, Eudorina,* and *Volvox.* A. G.

Algal Balls.—CAROLA I. DICKINSON ("Some Marine Algal Balls from Tasmania," *Annals of Botany,* 1933, 47, 253–9, 3 figs.). In describing the nature of some algal balls collected on a sandy beach at Kingston in Tasmania, the author gives a summary of what is known of balls of *Cladophora Sauteri* and of *C. holsatica* formed in fresh-water lakes; balls of *Posidonia* fibre found on the Riviera shores; compact balls of *Sphacelaria cirrosa* described by Wittrock, as developed by a radiating growth. The Tasmanian balls are composed of the alga *Halopteris funicularis,* a member of the Sphacelariaceæ, and are mechanical accretions of algal debris around a core of shell or polyp origin; they are comparable with *Posidonia* balls. A. G.

Crimean Algæ.—N. WORONICHIN ("Zur Kenntniss der Algenflora und Algenvegetation in den Süsswasserbecken der Krim," *J. Botanique de l'U.R.S.S.*, 1932, 17, 265–325, 5 pls.). An account of the fresh-water algæ of the Crimea, comprising 124 species, seven of which are new to science. The algæ of reservoirs in the Crimea show much resemblance to those of Western Europe and Transcaucasia; this is shown by the occurrence of species of *Chamæsiphon, Fridæa, Phæodermatium,* and other genera. The finding of *Pleurocladia lacustris* in mountain streams of the northern slope of Jaïla is perplexing. A characteristic trait of the algæ of the mountain streams is the tendency to deposit $CaCO_3$ in such quantity that the algæ are completely embedded, and in some cases it is a question whether one is dealing with tufa-building or perforating algæ. A. G.

Spirocladia.—F. BØRGESEN ("On a New Genus of the Lophothalieæ," *K. Danske Vidensk. Selsk. Biol. Medd.*, 1933, 10, no. 8, 1–16, 10 figs.). Description and figures of the structure of *Spirocladia,* a new genus of the Lophothalieæ belonging to the family Rhodomelaceæ. It was cast up in some quantity on the coast of Okhamandal in the State of Baroda, India. The trichoblasts are spirally placed on the stem and are characterized by spirally arranged ramelli. The affinity is with *Wrightiella.* A. G.

Development of Phæophyceæ.—HARALD KYLIN ("Über die Entwicklungsgeschichte der Phæophyceen," *Lunds Universitets Årsskrift.*, 1933, N.F., Avd. 2, 29, no. 7, 1–102, 2 pls., 35 figs.). The author has investigated the life-history of eighteen genera of Phæophyceæ by cultural methods, and describes and figures the stages of development in each case. He also discusses the alternation of generations and nuclear phases of the whole group; the biology of these algæ; and their taxonomy and affinities. A. G.

Pylaiella.—R. E. Schuh ("*Pylaiella fulvescens* (Schousb.) Bornet," *Rhodora,* 1933, **35**, 63, 64). A note on the discovery of *Pylaiella fulvescens* at North Brooklyn, Maine, with a brief mention of its distinctive characters. It is native of south-west Europe and Morocco, and has been found in the Canaries and the Virgin Islands.

A. G.

Pelvetia.—W. E. Isaac ("Some Observations and Experiments on the Drought Resistance of *Pelvetia canaliculata*," *Annals of Botany*, 1933, **47**, 343–8, 1 fig.). *Pelvetia* plants are often liable to air desiccation for days at a time during neap tides. Their capacity to grow in the upper limits of the litoral region is due to their tolerance of desiccation and to the protection afforded by the thick-walled mucilaginous oogonium to the two oospheres which it contains. A. G.

Macrocystis.—M. R. Levyns ("Sexual Reproduction in *Macrocystis pyrifera* Ag.," *Annals of Botany*, 1933, **47**, 349–53, 9 figs.). *Macrocystis* at Cape Town is fertile from October to June. Cultures started in June showed germination of zoospores after 24 hours. By seventeen days mature gametophytes, like those of *Laminaria*, were obtained; and one young sporophyte was seen. Antheridia and oogonia agree closely with those of *Laminaria*. Fertilization takes place within the oogonium, and the zygote is extruded in the same manner as the egg is in other genera; for in *Laminaria*, etc., the egg is extruded before fertilization.

A. G.

Indian Algæ.—F. Børgesen ("Some Indian Green and Brown Algæ especially from the Shores of the Presidency of Bombay. III," *J. Indian Bot. Soc.,* 1933, **12**, 1–16, 5 pls., 7 figs.). A series of notes, figures, and descriptions of marine algæ from the Bombay Presidency, comprising five green and eight brown species. *Struvea tuticorinensis* and *Chamœdoris auriculata* are new to science. Critical notes on the species of *Sargassum* elucidate a difficult group. A. G.

Japanese Algæ.—Yukio Yamada ("Notes on Some Japanese Algæ. V," *J. Faculty Sci. Hokkaido Imperial Univ.*, 1933, Ser. V, **2**, 277–85, 4 pls.). Twelve species from various Japanese localities are discussed, and five of them are new to science, belonging to the genera *Bornetella, Caulacanthus, Chrysymenia, Farlowia, Ptilonia.* A. G.

Indian Characeæ.—G. O. Allen ("Charophyte Notes from Agra, U.P." *J. Indian Bot. Soc.*, 1933, **12**, 17–19, 1 pl.). In the dry, warm climate of Agra Characeæ are few. Only the following were found: *Nitella hyalina, Chara aspera, C. fragilis, C. contraria, C. vulgaris. Chara aspera* was found in a deep pool in the river Chambal, and is an addition to the Indian flora; a figure and some structural notes are given. A. G.

Fungi.

A Parasitic Chytrid.—J. Bayley Butler and A. Humphries ("On the Cultivation in Artificial Media of *Catenaria anguillulæ*, a Chytridiaceæn parasite of the ova of the liver fluke, *Fasciola hepatica*," *Scient. Proc. Roy. Dublin Soc.,*

1932, **20**, 301–24, 6 pls., 28 figs.). Details are given of the cultivation in various media containing aqueous extract of fluke eggs with or without agar and/or egg albumen. Mycelial production was more extensive in culture than in nature. In one case a single thallus produced over twenty hyphal strands. Zoospores were successfully germinated and in turn gave rise to thallus, sporangia and zoospores. The morphology of the rhizoids, the occurrence of turbinate organs, and the systematic position of the organism is discussed. Five plates consist of outline drawings, while the last shows the structure of the fungus in four microphotographs.

F. L. S.

Monoblepharidales.—F. K. SPARROW, Jr. ("The Monoblepharidales," *Ann. Bot.*, 1933, **47**, 517–42, 1 pl., 2 figs.). An account of the history, methods of collecting, development, structure, and life history of this order of aquatic Phycomycetes. The reproductive organs of *Monoblepharis* are of three types: zoosporangia, bearing posteriorly uniciliate zoospores; antheridia, with antherozoids smaller but otherwise similar to the zoospores; oogonia, each containing a single, uninucleate egg. The mature plant of *Gonapodya* is similar to *Monoblepharis*, but the mycelium has pseudo-septæ. Sporangia bearing zoospores and encysted sporangia are the only known reproductive organs of this genus. The paper includes an account of the taxonomy of the species, a description of a new variety, and a discussion of the phylogeny and distribution. F. L. S.

Pilaira.—R. S. ANDERSON ("The Validity of the Genus *Pilaira*," *Univ. of Iowa Studies*, 1933, **15**, 3–5, 1 pl.). Single spore cultures of *Pilaira anomala* remained true and did not give rise to a *Pilobolus* form. Further, two rabbits free from either fungus were fed one with *Pilaira* and the other with *Pilobolus* on lettuce. The dung in each case produced the respective fungus only. Consequently, as the two genera are constantly distinct in culture, the author concludes that the genus *Pilaira* van Tiegh. is valid. F. L. S.

Penicillium Fruits.—B. O. DODGE ("The Perithecium and Ascus of *Penicillium*," *Mycologia*, 1933, **25**, 90–105, 2 figs., 2 pls.). A new homothallic species, *Penicillium Brefeldianum*, isolated from the human alimentary tract, was grown from single spores. Its conidia belong to the monoverticillate group. Ascocarps were readily produced in culture. The asci arise as lateral or terminal buds from an ascogenous branch and are cut off by septa, much as in *Thielavia Sepedonium*. Asci in this *Penicillium* and in *P. javanicum*, which was also examined, rarely arise in chains. The investigation is believed to prove that there is a group of species which bear perithecia comparable to the perithecium of *P. glaucum* described by Brefeld. F. L. S.

Lolium Fungus.—J. GÜNNEWIG ("Beiträge zur Kenntnis und Bedeutung des *Loliumpilzes*," *Beit. Biol. Pflanz.*, 1933, **20**, 227–54). The presence of a fungus around the seed-coats of species of *Lolium* has been known for some time, although its systematic position remained a problem. The author of this paper obtained from the micropyles of sterilized seeds hyphæ which invariably turned out to be *Chætomium Kunzeanum*. A number of physiological experiments were made: the fungus and infected and non-infected plants all grew more satisfactorily in nitrogen media. No final conclusion was reached as to the significance of the fungus in the life of its hosts, although infection experiments were carried out.

F. L. S.

Dermea and Pezicula.—F. J. SEAVER and J. VELASQUEZ ("*Dermea* and *Pezicula*," *Mycologia*, 1933, **25**, 139–50, 1 fig., 4 pls.). This is a re-examination of

the two genera. They are difficult to separate on ascospore characters alone, hence the authors have considered conidial differences and accompanying apothecial characters in their analysis. A new combination (in *Dermea*), and a new species (in *Pezicula*), are made. The paper is preliminary to a companion volume (on *Inoperculatæ*) to Dr. Seavers' North American Cup—Fungi (*Operculatæ*).

F. L. S.

New Basidiomycetes.—S. C. TENG and L. LING ("Some New Species of Fungi," *Contr. Biol. Lab. Sci. Soc., China*, 1932, **8**, 99–101, 1 pl., 2 figs.). One species each of *Boletus*, *Dædalea* and *Lenzites* are described new to science. The outstanding characters of the *Boletus*, which belongs to the section *Subtomentosi* of the series *Euchroi* are the large, angular, yellowish-green pores, the squamulose pileus and the length of the stipe.

F. L. S.

Truffle Localities.—H. LOHWAG ("Über Trüffelvorkommen," *Verhandl. d. Zoolog. Botan. Gesellsch. Wien*, 1932, **82**, 117–23). An account of a truffle-hunting excursion in the district between Neunkirchen and St. Egyd in lower Austria, where the author noted that the area of vegetation circumscribed by these underground fungi, *Tuber æstivum*, was a brownish-green in contrast to the fresh green of the surrounding plants. This brown fairy ring consisted largely of a growth of *Festuca rubra* L., and thus makes another sign in addition to those already known, such as peculiar odour, occurrence of *Helianthemum*, and certain beetles, whereby the presence of truffles may be detected.

F. L. S.

A Rare Smut.—W. STEC-ROUPPERTOWA (" *Tilletia separata* J. Kunze, rz adka śnieć na mietlicy zbożowej z Polski," *Act. Soc. Bot. Poloniæ*, 1932, **9**, 539–47, 4 figs.). In 1930 *Tilletia separata* was found on *Apera Spica-venti* on thirteen occasions, and in 1931 seventeen times. A map of Europe is given showing how rarely this smut has been recorded: twice in Czechoslovakia, four times in Germany, once in France, and once in Russia. A table is given showing 100 spore measurements. The spores of *T. decipiens* were also measured. The figures include drawings of spores and of healthy and diseased ears.

F. L. S.

Meiosis of Smuts.—W. HÜTTIG ("Über physikalische und Chemische Beeinflussungen des Zeitpunktes der Chromosomenreduktion bei Brandpilzen," *Zeitschr. f. Bot.*, 1933, **26**, 1–32, 9 figs.). When germinating promycelia of *Ustilago Avenæ* and *U. decipiens* were subjected to temperatures varying between 9°–30° C., and the percentage of pre-reduction calculated optimum curves were obtained. The optimum varied for each species and coincided with the optimum germination temperature. Minimum curves for pre-reduction generally resulted when spores of *U. Avenæ* were grown on different alkaline media. Variations in humidity, osmotic pressure and P_H values had no influence on the time of reduction.

F. L. S.

New Uredinales.—J. C. ARTHUR and G. B. CUMMINS ("New Species of Uredinales," *Ann. Myc.*, 1933, **31**, 41–5, 1 fig.). A description of twelve new species and of one new genus, *Atelocauda*, with *A. incrustans* as type species.

F. L. S.

Uromyces.—N. HIRATSUKA ("Studies on *Uromyces Fabæ* and its Related Species," *Jap. J. Bot.*, 1933, **6**, 329–79, 2 pls., 14 figs.). Comparative morphological studies of *Uromyces Fabæ* and its allies on thirteen species of *Vicia* led the author to distinguish three species: *U. Fabæ* (Pers.) De By with three biologic forms, *U. Orobi* (Pers.) Lév. with two forms, and *U. Ervi* (Wallr.) West. A large number

of inoculation experiments were made, and details are given of the range in structural variations of the forms in different hosts and of the distribution of the fungi in Japan. *U. Ervi* is regarded as intermediate between Eu- and opsis-forms.

<div align="right">F. L. S.</div>

Dominican Rusts.—F. D. KERN, R. CIFERRI, and H. W. THURSTON, Jr. ("The Rust Flora of the Dominican Republic," *Ann. Myc.*, 1933, **31**, 1–40). The list of 180 rusts includes all those so far known for this island, the fifty-five species reported for the first time are clearly indicated, seventeen genera are represented in addition to the form-genera, *Æcidium* and *Uredo*. Six new species are described. The mesophytic regions and the Savannas were found to be the areas richest in rusts. Wet regions, such as the rain forests, have few rusts, while the semi-arid and arid regions are the poorest in numbers of species. A host index and selected bibliography are included.

<div align="right">F. L. S.</div>

New Agaric.—A. PILÁT ("*Nemecomyces* g.n., agaricinearum ochrospori-carum genus novum mongolium," *Ann. Myc.*, 1933, **31**, 54–5). A concise yet full description of an agaric which at first sight recalls *Armillaria imperialis* Fr.

<div align="right">F. L. S.</div>

Volvate Agarics.—S. IMAI ("Studies on the Agaricaceæ of Japan. I. Volvate Agarics in Hokkaido," *Bot. Mag.*, 1933, **47**, 423–32). Synonyms, habitat, and distribution are given with the list of previously known forms, and full descriptions accompany the five species of *Amanita* and the two of *Amanitopsis* new to science.

<div align="right">F. L. S.</div>

Collar of Amanita.—H. LOHWAG ("Zur Kenntnis der Manschette von *Amanita*," *Ann. Myc.*, 1933, **31**, 126–33, 2 figs.). The author examines the structure and development of the ring in this fungus, and concludes that it originates from the gills and is homologous with the cap of *Phallus* and its allies.

<div align="right">F. L. S.</div>

European Amanitas.—R. VESELÝ ("Revisio critica Amanitarum europearum," *Ann. Myc.*, 1933, **31**, 209–99, 7 figs., 17 pls.). The genus is divided into three sub-genera : *Amanita, Amanitopsis*, and *Lepidella*. *Amanita*, which includes fifteen species, is in turn subdivided into sections depending on the structure of the volva, whether large and free or fused with the base of the stipe or fused and breaking up into squamules. *Amanitopsis* contains the one species *Amanita vaginata* Bulliard, while *Amanita Vittadinii* Moretti represents the sub-genus *Lepidella*. Synonyms, literature and illustrations are cited at length for every species. These are then described under the heads pileus, lamellæ, stipe, annulus, volva, odour, basidia, and spores. Notes are added on habitat, geographical distribution, and on variability in form and colour. The figures are drawings of sections of the lamellæ, the plates are photographs of species. The paper concludes with a list of names and synonyms.

<div align="right">F. L. S.</div>

Variations in Rhodotus palmatus.—M. A. POUCHET ("Considérations sur *Rhodotus palmatus* (Bull., Fries) R. Maire, et sur ses variations," *Bull. Soc. Myc. de Fr.*, 1932, **48**, 76–84, 1 fig., 1 pl.). The variations concern the colour of the spores in mass, the structure of the pileus, the conidia or chlamydospores, and the presence or absence of collar and cystidia. Drawings are made of the variations in shape of the cystidia-like outgrowths on the cap, and there is a list of literature referring to this somewhat rare fungus.

<div align="right">F. L. S.</div>

Modifications in Coprinus.—D. JORDANOFF ("Der Einfluss der Narkotisierung auf die Entwicklung einiger arten der Hymenomycetengattung *Coprinus*," *Œsterreich. Bot. Zeitschr.*, 1932, 81, 167–93, 8 figs.). When *Coprinus sterquilinus*, *C. fimetarius*, and *C. niveus* were subjected to ether or chloroform vapour during definite developmental stages, between the first and second or after the second divisions of the diploid nucleus of the basidium, either more or less than four sterigmata and spores were formed respectively. In the case of one, two, or three spores they were generally larger than normal, and might be borne on a single sterigma. In *C. fimetarius*, a normally heterothallic form, the large spores produced mycelia bearing diploid fruits, the nuclei contained both sex factors, and the fungus behaved as if it were homothallic. These conditions were not inherited, the next generation being normal again. Definitely pathogenic conditions result in prolonged treatment with the narcotic, e.g. large lobed spores or groups of spores resting directly on the basidia. Such spores did not germinate. The conclusion drawn is that the changes produced are modifications, not mutations.

F. L. S.

Agarics of Denmark.—J. E. LANGE ("Studies in the Agarics of Denmark. Part IX. *Tricholoma. Lentinus. Panus. Nyctalis.*" *Dansk Bot. Arkiv.*, 1933, 8, 1–44, 1 pl.). The author continues his examination of Danish Agarics, giving systematic keys and full specific descriptions and localities of the four genera as they occur in Denmark. His aim is to get all closely related species united within a group, not shifted among different genera, therefore species such as *Agaricus grammopodius* and *A. calathus* which, on account of their decurrent gills and cartilaginous stem, might be placed in *Clitocybe* or *Collybia*, are relegated to *Tricholoma*, close to *T. melaleucum* and *T. sordidum* respectively. The same is done with the tricholomoid Armillarias which are referred to *Tricholoma*, Armillaria being retained for *A. mellea* and its closest allies. Detailed examination was made of cystidia, spores, basidia and the cuticle of the cap. F. L. S.

Conidia of Pholiota.—P. MARTENS and R. VANDENDRIES ("Le cycle conidien haploïde et diploïde chez *Pholiota aurivella*," *La Cellule*, 1933, 41, 337–88, 3 pls., 62 figs.). The primary, haploid mycelium from a monobasidiospore bears oidia, which in turn will produce hyphæ and oidia. The secondary, diploid cultures bear clamps and three kinds of spores. Oidia, cylindrical cells formed in chains and set free by fragmentation, each of which receives a dikaryon and on germination gives rise to diploid hyphæ and oidia. Chlamydospores, large ovoid cells with thick walls, which are diploid and in turn form a diploid mycelium. Conidia, fusiform and born singly or in clusters on short stalks; each contains two nuclei, but a transverse wall is laid down between them. The conidium may behave in one of two ways. It may be set free in its two-celled state, the separating wall becomes reabsorbed, the original dikaryon being obtained and on germination forms a diploid mycelium. Or, in the second case, each cell of the bicellular conidium breaks away and behaves as a haploid oidium. Thus there is a regular alternation in the conidial cycle, the transverse walls forming a pseudo-reduction.

F. L. S.

Marasmius on Buxus.—J. FAVRE ("Le marasme du buis (*Marasmius Buxi* Quélet)," *Schweiz. Zeitschr. f. Pilzk.*, 1933, 11, 7–9, 1 fig.). This rare fungus was found on *Buxus sempervirens* in March in the vicinity of Châtillon-de-Michaille, near Bellegrade. It is described and illustrated, and an account is included of the distribution of *Buxus* in Europe. F. L. S.

American Poria in Europe.—A. PILÁT ("De *Poria aurea* Peck, specie americana in montibus Carpaticis orientalibus lecta," *Hedwigia*, 1933, **73**, 31–3, 1 fig., 1 pl.). This fungus, previously found by Overholts in New York, was discovered on trunks of dead *Picea excelsa* in woods of the east Carpathians in the district of Tiačevo. It is redescribed and figured.   F. L. S.

Dacrymycetaceæ.—G. W. MARTIN and M. C. FISHER ("The Genera of the Dacrymycetaceæ," *Univ. of Iowa Studies*, 1933, **15**, 8–14, 1 pl., 11 figs.). These critical notes on the nine genera which are fairly easily definable include a key for their recognition and an enumeration of doubtful genera. The figures are diagrams showing the variation in form and the position of the hymenium in the different members of this family.   F. L. S.

Tremella.—A. M. LOONEY ("A Morphological Study of Certain Species of *Tremella*," *Univ. of Iowa Studies*, 1933, **15**, 17–33, 3 pls., 27 figs.). This attempt to clear up some of the confusion in this genus begins with a concise account of the relevant literature on the taxonomy. This is followed by two discussions, on *Tremella frondosa* and *T. foliacea* and on *T. lutescens* and *T. mesenterica*. A very careful structural study, especially of the basidia and spores, leads the author to conclude that the two latter are synonymous, and that while there is also much evidence for the synonomy of *T. frondosa* and *T. foliacea*, there is as yet no absolute proof.   F. L. S.

New Tremella.—D. H. LINDER ("*Tremella gangliformis*, a New and Unique Tremellaceous Fungus," *Mycologia*, 1933, **25**, 105–9, 1 fig.). The fungus appeared in the form of white gelatinous pustules connected by strands running over a wet decaying elm in Missouri. The longitudinally cruciate basidia arise just below the surface and bear ovoid spores, which on germination produce bacteria-like sporidia at the end of a short germ-tube. Many of the hyphæ, similar to those from which the basidia arise, divide and form sterile paraphysoid structures, which make up the bulk of the fruiting body.   F. L. S.

Gasteromycetes.—E. FISCHER ("Gastromyceteæ Stahelianæ," *Ann. Myc.*, 1933, **31**, 113–25). A critical and morphological account of the Gasteromycetes collected by Prof. Stahel in Paramaribo and in the coastal districts of Surinam. In re-examining the vexed question of the peridial pseudo-parenchyma in *Protubera maracuja* he concludes that it is not of hymenial origin. A number of new species are proposed and their structure is described in detail.   F. L. S.

Gasteromycetes.—E. FISCHER ("Unterklassi Eubasidii. Reihe Gastromyceteæ," *Engler-Prantl, Natürlicher Pflanzenfamilien, Leipzig*, 1933, **7A**, iv + 122, 91 figs.). This, the second edition, is greatly improved and enlarged, and contains many more figures than the original. A list of the most important literature precedes a general account of the structure, reproduction, cytology, and classification of this group, which is divided into six orders, Hymenogastrineæ, Sclerodermatineæ, Nidularineæ, Lycoperdineæ, Phallineæ, and Podaxineæ. The generic keys and diagnoses and enumeration of species conform with those in the other volumes in this series.   F. L. S.

Swedish Micromycetes.—C. HAMMERLUND ("Beiträge zur Kenntnis der Mikromycetenflora der Provinz Skåne (Schonen)," *Ark. Bot.*, 1933, **25**, 1–126, 3 pls., 16 figs.). This enumeration with notes of the fungi occurring in the southernmost province of Sweden ranges over 196 genera. To each parasite, saprophyte, or epiphyte is added a list of all hosts on which it has been found. The first plate

illustrates the life-history and structure of two new fungi, *Olpidium Pisi* and *Mitrula Brassicæ;* the other two plates show *Epichloe typhina* in the ears of *Poa pratensis* and the spermogonia and æcidia of *Puccinia mirabilissima.*

F. L. S.

Polish Fungi.—W. Zabłocka (" Grzyby Kapelusrowe Zarytego Koło Rabki," *Act. Soc. Bot. Pol.*, 1932, **9**, 199–216). A list of 104 of the larger Basidiomycetes found in Zaryte near Rabka, together with notes on habit, locality, structure, and size of spores. F. L. S.

Brigantine Fungi.—R. Heim and L. Remy (" Fungi Brigantianti. Espèces rares ou nouvelles de Discomycètes des Alpes Brianconnaises," *Bull. Soc. Myc. de Fr.*, 1932, **48**, 53–76, 2 pls., 11 figs.). A detailed structural account of eight fungi, two of which are new to science, with good drawings of spores, asci, and paraphyses.

F. L. S.

Bologna Fungi.—G. Goidánich (" Intorno ad alcuni micromiceti nuovi o rari," *Ann. Myc.*, 1933, **31**, 134–43, 2 pls.). A detailed account of one variety and three species of Hyphomycetes new to science. *Mesobotrys macroclada*, a rare fungus, which was found on *Sambucus*, also is figured, and its structure and position in the genus critically examined. F. L. S.

Spanish Fungi.—M. J. de Urries y Azara (" Algunos datos para la flora española de micromicetos," *Bol. Soc. Esp.*, 1933, **33**, 91–105, 3 figs.). Sixty-seven fungi are described or listed, four of which are new species. F. L. S.

Morocco Fungi.—L. M. Unamuno (" Notas micológicas. Más especies de hongos microscópicos de muestro Protectoradomarroquí," *Bol. Soc. Esp. Hist. Nat.*, 1933, **33**, 31–44, 6 figs.). Of the forty-four species described, five are new : *Puccinia Parorychiæ, Tilletia Narduri, Sphærella Putoriæ, Parodiella Andryalæ*, and *Septoria Magydaridis.* F. L. S.

Indian Fungi.—H. Sydow and J. H. Mitter (" Fungi Indici. I," *Ann. Myc.*, 1933, **31**, 84–97). Some micro-fungi of N.E. India are described, together with one new genus, *Mitteriella*, and eleven new species. F. L. S.

Siberian Fungi.—A. Pilát (" Additamenta ad floram Siberiæ Asiæque orientalis mycologicam," *Bull. Soc. Myc. de Fr.*, 1932, **48**, 1–52, 8 pls., 8 figs.). This is a list of over 100 Basidiomycetes the localities, and hosts of which are cited and for the majority detailed descriptions are given, with drawings of structural details. There are photographs of twenty-five species. Five new combinations, nine new forms, and eight new species are described. F. L. S.

Chinese Fungi.—S. C. Teng (" Additional Fungi from South-western China," *Contr. Biol. Lab. Sci. Soc. China*, 1932, **8**, 1–5). An enumeration, with notes of species studied since the publication of the previous paper. F. L. S.

Fungi in Peking Herbarium.—L. Ling (" Enumeration of the Fungi in the Herbarium of the National University of Peking," *Contr. Biol. Lab. Sc. Soc. China*, 1932, **8**, 183–92). The list, which includes all the material in the herbarium with the exception of the agarics and clavarias which had lost their spores, original colour, and form, consists of one Myxomycete, three Ascomycetes, and forty Basidiomycetes. F. L. S.

Chekiang Fungi.—S. C. TENG ("Fungi of Chekiang I," *Contr. Biol. Lab. Sci. Soc. China*, 1932, **8**, 49–72). This is the first of a series of papers to be published with the purpose of giving definite records of the fungi of this district in the form of an enumeration. Two new species are described. F. L. S.

Nanking Fungi.—S. C. TENG ("Fungi of Nanking II," *Contr. Biol. Lab. Sci. Soc. China*, 1932, **8**, 5–49). This and a previous paper constitute a preliminary list of the fungi of Nanking, to which other species will be added in the course of time. As plant diseases are included, it will prove of value to pathologists in this locality. Seven new species are described. F. L. S.

Mycorrhizas.—L. K. HENRY ("Mycorrhizas of Trees and Shrubs," *Bot. Gaz.*, 1933, **94**, 791–800, 6 figs.). Mycorrhizas of three types, ectotrophic, endotrophic, and ectoendotrophic, were found on sixty different trees and shrubs, twenty-six of which are new additions to the list of mycorrhizal hosts, in woodland and field in Butler County, Pennsylvania. F. L. S.

Hymenomycetous Mycorrhizas.—A. B. HATCH and C. T. HATCH ("Some Hymenomycetes forming mycorrhizæ with *Pinus Strobus* L.," *J. Arnold Arboretum Harvard University*, 1933, **14**, 324–34, 2 pls.). Seedlings grown from sterile seeds were inoculated with pure cultures of a number of fungi, and ectotrophic mycorrhizal formations resulted. *Boletinus porosus*, *Lactarius chrysorheus*, and *Boletus castaneus* are thereby added to the list of known mycorrhizal organisms. Melin's technique was followed and is carefully redescribed, as it has been so often misquoted.

F. L. S.

Orchid Mycorrhiza.—J. and M. MAGROU ("Sur les variations d'activité des Rhizoctones d'Orchidées," *Ann. Sci. Nat. (Bot.)*, 1933, **15**, 303–5). The authors describe how they rejuvenated a strain of *Rhizoctonia repens*, which had lost its activity in artificial culture, by inoculating seeds of *Cattleya* with it. After some months the fungus had regained its original strength. The experiment confirms similar work on reactivation by Noel Bernard. F. L. S.

Diseased Pine.—J. B. MARTINEZ ("Una grave micosis del pino observando por primera vez en España," *Bol. Soc. Esp. Hist. Nat.*, 1933, **33**, 25–31, 6 figs.). A detailed illustrated account of the disease caused by *Excipulina pinea* (Karst.) v. Höhn. on *Pinus Pinaster*, *P. insignis*, and *P. sylvestris*. F. L. S.

Parasitism and Temperature.—K. TOGASHI and K. UCHIMURA ("A Contribution to the Knowledge of Parasitism of *Valsa Paulowniæ* in Relation to Temperature," *Jap. J. Bot.*, 1933, **6**, 477–87, 4 figs.). The minimum, optimum, and maximum temperatures for mycelial growth were below 5°, 22°–27°, and 30°–32° C. respectively. The fungus grows better at low temperatures than high. The authors conclude that the temperature relations of host and fungus are such as to lead to much parasitism, because even during the hottest and coldest times of the year the maximum and minimum temperatures respectively reached by *Paulownia tomentosa* are respectively below and above the maximum and minimum necessary for the growth of the fungus. F. L. S.

Preservation of Fungi.—A. J. EWART ("On the Preservation of Fungi," *Ann. Bot.*, 1933, **47**, 579–84, 6 figs.). Various ways of preserving fungi are described, but the most satisfactory method applicable to the most delicate kinds is to soak in a mixture of 2 parts of formaldehyde to 1 of liquid phenol, and after superficial drying to expose the specimen over strong ammonia until it sets solid without

drying. The appearance is somewhat like candied fruit. By soaking in spirit or water the impregnating material can be removed. By heating to over 100° C. the fungi can be bakelized, and are then unaffected by water.   F. L. S.

Kéfir Fermentation.—E. KORNBLUM ("Badania nad kefirami wars-zawskimi," *Act. Soc. Bot. Pol.* 1932, **9**, 421–57). Differences of opinion exist as to what organisms are responsible for the fermentation of milk in the production of Kéfir, *Bacillus caucasius* together with yeast being regarded usually as essential. The author describes his isolation of micro-organisms in the Kéfir of Varsovia and the production of this substance by inoculating milk with pure cultures of them. Three strains of *Streptococcus lacticus* Kruse, only two of which are characteristic of Kéfir, some oval yeasts resembling *Saccharomyces Kéfi r*and *Torula lactis*, and *Oidium lactis*. When milk was inoculated with different combinations of these organisms, it was found that the yeast and two strains of the *Streptococcus* were necessary for a normal Kéfir fermentation. The quality and taste varied according to the addition of other organisms and on the kind of milk used, but *B. caucasius* was never found nor was it necessary.   F. L. S.

Variations in Aspergillus.—H. C. GREENE ("Variations in Single Spore Cultures of *Aspergillus Fischeri*," *Mycologia*, 1933, **25**, 117–39, 5 figs.). The variations in 448 single spore cultures which were obtained from a stock culture of *A. Fischeri* were of two main types: I, with large scattered perithecia, in contrast to the small evenly distributed perithecia of the stock; II, with profuse conidia and few perithecia, in contrast to the ready production of fruits in the stock. In certain cases of type I the sub-cultures from ascospores or conidia remained constant to the variant, while in other cases, if derived from ascospores, they reverted to the original culture, but remained true to the variant if derived from conidia. All cultures from II remained true to the variant.   F. L. S.

Fungal Radiation.—RENÉ VANDENDRIES and H. J. BRODIE ("Les radiations sexuelles chez les champignons," *Compt. Rend. de l'Acad. Sci.*, 1933, **196**, 721–3). The spores of *Lenzites betulina* were found to be tetrapolar. The nucleus of the basidium bears four factors (which may be designated a, b, a', b'), two of which go to each basidiospore, but certain combinations of factors (aa', bb') cannot exist in the same spore (spores may be ab, $a'b'$, ab', $a'b$). To form a normal fruit all the factors must be reunited, and to obtain this only two combinations are possible, $ab \times a'b'$, or $a'b \times ab'$. This consideration is born out by all experiments. In certain sterile combinations a sexual barricade was noted, i.e. the mycelium from two incompatible spores stopped short of each other within a certain distance. The repulsion was apparently not chemical, as it is manifested even when the two growths were separated by mica, celluloid, or glass slips. This barricading is, however, prevented by strips of aluminium, copper, platinum, or lead, hence it is concluded that the phenomenon is one of radiation.   F. L. S.

Endophyte of Bucegia.—P. EFTIMIU ("Sur la présence d'un champignon chez *Bucegia Romanica* Radian," *Compt. Rend. de l'Acad. des Sci.*, 1933, **196**, 957–9). Fungal hyphæ were found in the female thalli of this rare and only recently described liverwort. The infested layer is immediately below the chlorophyll tissue and separated by several layers from the lower epidermis. To what group the fungus belongs and whether it was a parasite or mycorrhiza was impossible to determine.   F. L. S.

A Geotrichum.—ALDO CASTELLANI ("A New Variety of *Geotrichum matalense* (*Geotrichum matalense* var. *Chapmani*)," *J. Trop. Med. & Hygiene*, 1932, **35**, 278–80,

3 figs.). A structural and physiological description of a fungus which closely resembles *G. matalense*, the chief difference being the greater length of its arthrospores and their thicker walls. A table is given showing the biochemical reactions of the two fungi.   F. L. S.

Epidermophyton rubrum.—E. MUSKABLITT (" Observations on *Epidermophyton rubrum* or *Trichophyton purpureum*," *Mycologia*, 1933, **25**, 109–11, 3 figs.). The author, after reviewing the literature on these two confusing fungi, describes two types of cultures isolated from each of two patients. One is ceribriform and corresponds to *E. rubrum* Cast., the other is downy and agrees with *T. purpureum* Bang. The latter is not a pleomorphic form of the ceribriform type because it was white and downy from the original culture, it underwent sporulation and showed pleomorphic degeneration. Two explanations are suggested : that one and the same fungus exists in two stable varieties, or that there are two independent species which may occur in the same patient as a mixed infection.   F. L. S.

Tropical Mycoses.—ALDO CASTELLANI (" Epidemiological Notes on Some Tropical Mycoses," *Proc. Roy. Soc. Medicine*, 1932, **25**, 79–88). A general account of the most common tropical mycotic diseases. The internal mycoses described are tonsillomycoses and bronchyomycoses, of which tonsillomycoses membranacea, the causal agent of which is a species of *Monilia*, is perhaps the most important, as it closely resembles diphtheria, and the importance of distinguishing between the two is emphasized. Madura foot, Dhobies itch, Tinea flora, Tinea nigra, Blastomycosis certis, and Tokelau are the external mycoses considered.   F. L. S.

Tobacco Mosaic.—T. FUKUSHI (" On Some Properties of the Tobacco Mosaic Virus I," *Jap. J. Bot.*, 1933, **6**, 381–92). The virus was readily adsorbed by kaolin and alumina. The former was adsorbed more effectively in acid juices, with a p_H below 6. The virus was eluted by ammonia and attained its maximum virulence when the eluate had a p_H between 4 and 7.   F. L. S.

Virus Research.—K. M. SMITH (" The Present Status of Plant Virus Research," *Biol. Reviews & Biol. Proc. of the Cambridge Philosophical Soc.*, 1933, **8**, 136–79, 1 pl.). This and a previous review form a general survey for the student who may be much handicapped by the absence of any text-book on the subject. The paper is divided into a number of sections dealing with physical properties, symptomatology, transmission, attempted cultivation, photography, etc. The application of the different methods of study to the differentiation of plant viruses is discussed, and emphasis is laid on the importance of classifying the virus and not the disease. The work on potato mosaic is reviewed, and an extensive bibliography is appended.   F. L. S.

Myxomycetes

Japanese Myxomycetes.—Y. EMOTO (" Studien über die Myxomyceten in Japan," *Bot. Mag.*, 1933, **47**, 371–83). A recapitulation of the literature and research work on the slime-moulds of Japan with a chronological bibliography.
                                                                        F. L. S.

TECHNICAL MICROSCOPY

An Apparatus for the Examination of Opaque Minerals by Polarized Light.—The new method of examining opaque minerals by polarized light described by Dr. Jones at a recent meeting of the Society, requires a vertical illuminator of the prism type placed over the objective of the microscope, combined with a revolving prism to polarize the incident light. Messrs R. & J. Beck, Ltd., have produced this apparatus, and fig. 1 shows the construction of it. The
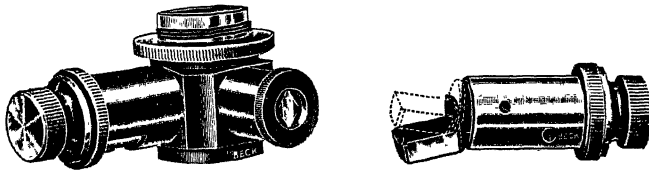
FIG. 1.
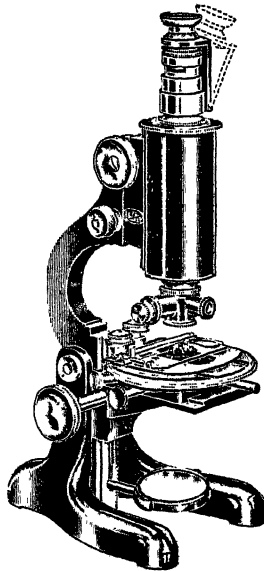
FIG. 2.

reflecting prism can be swung in two azimuths and the polarizing prism can be rotated. The whole apparatus can be revolved on the microscope for setting it, so that the plane of incident polarized light is at right angles to the plane of the reflecting surface of the prism, to prevent eliptical polarization at the reflection. Fig. 2 shows a microscope specially constructed for the use of this method in

which the illuminator can be set in a position level with the incident beam of light, and the focussing is done by a rack and pinion motion for raising and lowering the stage. A series of short mounted object-glasses are made in which the back lens is very close to the reflecting prism.

Microscopy of Zinc White.—P. KAMP (*Farben Chem.*, 1933, **4**, 129). As a dispersing medium for the microscopical examination of zinc oxide, an aqueous (0·5 p.c.) solution of the water-soluble cellulose, Glutolin S25, is recommended. This medium has a very low refractive index. A. H.

Some Notes on Beetles and their Damage to Hides and Leather.— F. O. FLAHERTY and W. T. RODDY (*J. Amer. Leather Chem. Assoc.*, 1933, **28**, 298). A description of the leather beetle (*Dermestes vulpinus* Fab.) and *Necrobia rufipes*, both of which attack hides with damage to the corium. When infected hide storage cellars are fumigated with HCN it seems unlikely that the gas has any effect on the quality of the leather produced from hides so treated. The paper is illustrated showing the method of damage. A. H.

Microscopical Examination of Rubber and Other Solid Technical Products.—F. H. RONINGER, Jr. (*Ind. Eng. Chem. Anal. Edit.*, 1933, **5**, 251–53). The difficulties encountered in preparing sections of tough, elastic and opaque products associated with rubber manufacture are emphasized. The procedure found most suitable is as follows : If containing textile fibre, the sample is given a molten sulphur cure by immersing in sulphur at 135° C. for 12–24 hours, avoiding blowing or distillation of the volatile constituents. It is then flattened on a coarse, loose-bond silicon-carbide grinding wheel at about 300 r.p.m., well flushing with water, followed by a rough polishing on a wool broadcloth saturated with a watery paste of " 600 " silicon carbide, and revolving at 300 r.p.m. The final polish is given on a silk-velvet cotton-backed cloth-covered wheel charged with a little high-grade magnesium oxide (Shamva) in water. Thorough flooding to remove particles is essential. The sample is now ready for examination. The method has been applied to the examination of the degree of dispersion of pigments in rubber mixes, and rubber tread stocks. It is suggested that a similar procedure can be applied to wood specimens. A. H.

NOTICES OF NEW BOOKS

Faune de France.—Vol. 26. Copépodes Pélagiques.—By M. Rose. 1933. 374 pp., 19 plates, 456 text-figs. Price 140 fr. Vol. 27. Tuniciers. Fascicule 1 : Ascidies.—By Dr. H. Harant and Paulette Vernières. 1933. 101 pp., 94 text-figs. Price 35 fr. Published by Paul Lechevalier, 12, Rue de Tournon, Paris, VIᵉ.

Le Teorie sull' Origine e l'Evoluzione della Vita (Da Darwin ai Nostri Giorni).—By Gustavo Brunelli. 1933. 200 pp. Published by Casa Editrice Licinio Cappelli, Bologna, Italy. Price L.20.

Zeiss Nachrliften.—Edited by Prof. Dr. F. Hauser. No. 3, March, 1933. 36 pp., 28 figs. Published gratis by Carl Zeiss, Jena, Germany.

Phytopathological and Botanical Research Methods.—By Thomas Elsworth Rawlins. ix+156 pp., 3 text-figs. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd, 11, Henrietta Street, London, W.C. Price 15s. 6d. net.

Cytological Technique.—By John R. Baker, M.A., D.Phil. 1933. xi + 131 pp. 3 text-figs. Published by Methuen & Co., Ltd., 36, Essex Street, London, W.C.2. Price 3s. 6d. net.

Cytologists have too long been content to adopt pragmatism as their only philosophy. If only the final preparations were satisfactory the rationale of the methods by which they were obtained mattered little. As a result text-books of cytological and histological technique have tended to resemble the pharmacopias of the Middle Ages. Recently, however, serious attempts have been made to extend the work initiated by Gustav Mann more than 30 years ago and thus to place cytological technique on a true scientific basis. The small monograph here reviewed, which forms one of a series on biological subjects, therefore appears at an opportune time. After a brief description of the living cell, fixation, embedding, staining, and mounting are discussed, the theoretical basis for each serving as an introduction to practical methods. There are many omissions, such as the lack of any mention of Zenker's fluid, Schridde's technique, or Hollande's method of staining frozen sections ; nevertheless even the most erudite cytologist will find in the book much of interest and instruction.   G. M. F.

An Index to the Genera and Species of the Diatomaceae and their Synonyms, 1816–1932.—Compiled by FREDERICK WM. MILLS, F.L.S., F.R.M.S. Part I, A. May, 1933. 74 pp. Part II, A. July, 1933. 74 pp. Part III, Am–At. August, 1933. 74 pp. Part IV, At–Bi. September, 1933. 74 pp. Published by F. W. Mills, Milton Damerel, North Devon ; and (for Colonial and Foreign subscribers) by Wheldon and Wesley, Limited, 2, 3 and 4, Arthur Street, New Oxford Street, London, W.C.2. Price by subscription, 10s. per part.

The index is the outcome of forty years' research into the perplexing question of synonomy in the Diatomaceae. The parts, which consist of seventy-four pages each, are published at intervals of six weeks. Part I contains the most complete bibliography that has ever been published, together with the commencement of the index, which is continued in Parts II and III as far as the genus *Attheya* West. The species and genera are arranged alphabetically, and every important reference to the species and its synonyms is given. The index comprises more than five hundred genera when complete, and will contain over half a million references to some sixty thousand species and varieties.

The work is an invaluable contribution to the literature, but it is hoped that more care will be exercised in the production of future parts so as to eliminate the many errors in spelling that mar the first three parts.

N. I. H.

Foraminifera, Part II. South Georgia.—By ARTHUR EARLAND, F.R.M.S. 1933. (Discovery Reports, Vol. VII, pp. 27–138, plates I–VII.) Published by the Discovery Committee, Colonial Office, London. Obtainable from Cambridge University Press, Fetter Lane, London, E.C.4. Price 16s. net.

This beautifully printed and illustrated monograph, which forms Part II of the description of the " Discovery " foraminifera, is a notable addition to the literature, by no means scanty, of recent foraminifera from the Antarctic area. It is written on the lines of the long series of fine memoirs by Heron-Allen and Earland.

Although relatively close to the Falkland Islands, whose fauna was described in the first part of the work, the foraminifera are largely distinct, and this applies more particularly to those from the coastal area. This is due to the fact that the Falkland area is one of generally shallow sea, with sandy bottoms, and, lying within the Sub-Antarctic region, is free from ice. The South Georgia area, on the contrary, is surrounded by deep seas, is within the region of the pack-ice, and the coastal deposits are of tenacious blue mud with an abundance of diatoms. The cold-water loving arenaceous forms play a great part in the fauna. Bottom samples from some ninety stations were examined, over fifty of these being from the shallower coastal waters, while the remainder came from deep sea.

Three hundred and forty-five species and varieties are recorded, including five new genera and thirty-three new forms, but of these the new genera and twelve of the new forms have already been described by Heron-Allen and Earland in this Journal. Of the new genera *Gordiospira* is porcellanous, *Pelosphæra, Armorella*, and *Hippocrepinella* arenaceous, and *Miliammina* finely arenaceous with a siliceous cement. Of these *Miliammina* with five species is of the greatest interest, and a new sub-family Silicininæ is proposed to contain the genus, together with *Silicosigmoilina* and *Rzehakina*.

Until the opinions of authors on the foraminifera are much more in agreement than is at present the case, it is difficult to take too seriously the various systems of classification proposed, and Earland's retention of a modification of that of Brady

has, provisionally, much to recommend it. And until some of the modern proposals regarding the phylogeny of the foraminifera are based more on fact than imagination, it may perhaps be suggested that phylogeny as a basis for classification, however theoretically desirable, may without offence be left in the background. As an extreme instance, in the case of a considerable treatise published this year, one form which the author admits is so ill-known that he himself suggests it may be an ostracod, is gravely placed as the ancestor of an undoubted foraminifer !

As a very minor criticism of the present memoir it is a little difficult to see why the generic names *Biloculina* and *Truncatulina* are retained instead of the earlier *Pyrgo* and *Cibicides* respectively, since other early names of the revised nomenclature are adopted. The retention of certain other generic names as, particularly, *Cristellaria* and *Polymorphina* is perhaps a matter of controversy but one which has much to recommend it ; as regards *Pulvinulina* this is more questionable.

W. A. M.

XVI.—CHROMOSOME STUDIES IN ALLIUM.   576.312.3.

I. THE SOMATIC CHROMOSOMES.

By T. K. KOSHY, M.A., F.R.M.S., F.L.S.

(Professor of Botany, Trivandrum, Travancore.)

(*Read October 18th, 1933.*)

THREE PLATES.

I. *Historical Survey.*

THE members of the genus *Allium* have been favourite plants for cytological investigations since 1884, when Guignard first studied the structure and division of the cells in *A. ursinum.* Strasburger (1888) and Schaffner (1898) examined the formation of the achromatic spindle in *A. ursinum* and *A. cepa* respectively, and Němec (1899) found an axial vacuolization in the chromosomes of *A. cepa.* Merriman (1904) observed a quadripartite structure in the anaphase chromosomes of the same species and found in its resting nuclei chromatin granules distributed in the linin network. Grégoire (1906) developed his alveolar view of chromosome structure from his work on three species of *Allium (A. cepa, A. ascalonicum,* and *A. porrum).* Bonnevie (1908) found in the chromosomes of *Ascaris, Allium,* and *Amphiuma* a heavy outer portion composed of coiled threads and a less dense interior. In the telophase chromosomes of *Salamandra* and *Allium,* De Horne (1911) observed a pair of interlacing spirals, while Lundegårdh (1910) saw in *Allium cepa* and *Vicia faba,* only an alveolar structure. Reed (1914) investigated the nature of the double spireme in *A. cepa,* Haberlandt (1923) traced the

development of the embryo in *A. odorum*, and Taylor (1925a) and Levan (1932) studied the morphology of the chromosomes of certain species of this genus. Sharp (1929) and Eichhorn (1931) observed in the chromosomes of *Allium* two interlacing chromonemata in all mitotic stages. In addition to these, the chromosome numbers (Gaiser 1930) in the different species of this genus have been ascertained by several investigators.

The cytology of this genus has thus been thoroughly investigated; but there is such diversity of opinion regarding the structure and mode of division of its chromosomes, that a reinvestigation of these problems on the same materials appeared desirable. A study of the chromosomes of a few species of *Allium* was therefore undertaken in the Department of Botany, King's College, London, under the supervision of Prof. Ruggles Gates, F.R.S.

The present paper will be confined to the internal structure and division of the somatic chromosomes of *Allium*. It deals more fully with a new view of chromosome structure, a preliminary report of which was published in *Nature*, Vol. 131, p. 362. The structure and behaviour of the meiotic chromosomes of this genus will form the subject of a subsequent paper.

II. Material and Methods.

Bulbs of four species of *Allium* (*A. cepa*—onions, vars. Reading and Bedfordshire Champion, *A. ascalonicum*—shallots, *A. sativum*—garlic, and *A. porrum*—leeks) were kindly sent by Messrs. Sutton and Sons, Reading. These were grown in pots of moist sand as well as in jars with water. About a quarter of an inch of the tips of the roots, grown in these cultures, was cut off in the fixing fluid with a pair of sharp scissors. An exhaust pump was invariably used to ensure sudden penetration of the fixing fluid. The roots were usually fixed between 10 a.m. and 1 p.m.

The fixing fluids were:

(1) Flemming's medium fluid.

(2) Flemming's medium fluid modified by using uranic acid instead of osmic acid.*

(3) La Cour's (1931) fluids 2B and 2BE.

(4) Merkel's fluid.

(5) Taylor's (1925) fluid.

The formulæ of fluids (1) and (4) were those given by Chamberlain (1928).

Although most of these fluids gave satisfactory results, the best preparations were those fixed in osmic acid mixtures.

The material was fixed for 18–21 hours. After thorough washing, it was passed through alcohol grades beginning with 5 p.c. and was cleared in chloroform. Microtome sections of thickness ranging from 4μ–20μ were taken and stained in iodine gentian violet.

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* This modification of Flemming's fluid was first introduced here by Mr. Semmens of this department.

III. *Structure of Chromosomes.*

(*a*) *Preliminary Statement.*—A brief summary of my observations and interpretations of the somatic chromosome cycle is given in order to facilitate detailed description. The scheme here outlined for the chromosomes of *Allium* appears to approach more closely their real structure than any so far given ; but only future researches can show in what particulars it must be modified to conform to conditions in other plants and animals and how far it is applicable in meiosis.

In the early metaphase, the chromatic constituent of each chromosome is seen as two twisted chromonemata embedded in a matrix of achromatic substance. The twisting of the chromonemata is in opposite directions in the two arms of each chromosome, the null-point being its attachment constriction. The chromosomes soon arrange themselves at the equator of the spindle and are held fixed by the spindle fibre attachments at the constrictions. The twisted threads then unwind from the ends of the chromosome towards the constriction. This unwinding causes rotation in each arm of the chromosome, and it is presumable that, as a result of this rotary motion, longitudinal cleavage, which is initiated in the prophase, is completed in each chromonema. The daughter chromosomes, after remaining side by side for a short time, separate and move towards the poles of the spindle. This separation commences at the constriction and is probably brought about by the " pull " of the spindle fibres. On reaching the pole the daughter chromosomes aggregate, forming the so-called " polar clumps."

A nuclear membrane is now formed and one or more nucleoli appear in each daughter nucleus. The " clumping " of chromosomes marks the maximum contraction of the double coil of each. This stage is followed immediately by an extension of the coil and elongation of the threads. The so-called " alveolar " appearance of chromosomes at this stage is due to the clear areas in the chromosome which the loops of the double coil enclose during their extension. As such extension proceeds these areas become narrower and finally disappear. At the late telophase the two threads become so closely approximated that their duality is completely obscured. The nuclear membrane, which makes its appearance after the polar clumping, restricts the linear expansion of these twisted threads and, consequently, they are thrown into folds, presenting the characteristic zigzag appearance.

After a period of rest the threads begin again to contract. The diamond areas reappear, and the double spiral aspect of the chromosomes is again brought to view. With the disappearance of the nuclear membrane the chromosomes lose any folds or bends which may have been present as a result of the restricted movement within the membrane. At this stage of prophase the characteristic mode of coiling is clearly made out, and a spiral cleavage appears to be initiated in each thread for the following mitosis. The chromosomes then arrange themselves at the equator of the

spindle and, after unwinding, their halves move to the opposite poles of the spindle.

(b) *Description.*—The following account of the chromosome cycle does not present the changes undergone by the chromosomes in one species of *Allium ;* rather, it takes up the phases in turn, describing whatever chromosomes have yielded information, regardless of the species. The metaphase is considered first, as the chromosomes at this stage reveal their structure better and because the two important activities of the cell, viz. the separation of chromosome-halves and the completion of division for the following mitosis are carried out here.

All drawings are of the same magnification with the exception of fig. 17, pl. II, which shows only half as much enlargement. This smaller scale drawing is introduced with a view to bringing in the general features of the entire cell at a critical stage in the mitotic history of the chromosomes. All *a* figs. are photomicrographs of cells in different stages. For a clear presentation of the different appearances of chromosomes in the mitotic cycle, the stages of a single chromosome are shown in *b* figs. Fig. 28, pl. I, is a photomicrograph of a spiral vessel of *Elettaria,* which shows structural peculiarities comparable to those of chromosomes. The structure of chromosomes as interpreted by me is illustrated by means of photographs of wire models in pl. I, figs. 1–8.

Metaphase.—The disappearance of the nuclear membrane at the end of prophase gives freedom of movement to the chromosomes. Their arms then straighten and they gradually arrange at the equatorial plane of the cell. Each chromosome at this stage shows an achromatic matrix within which the chromatic element is seen as two threads (chromonemata), which are twisted about one another. Careful examination of the mode of coiling of the chromonemata in the two arms of each chromosome has shown that there is a reversal in its direction from one arm to the other. The attachment constriction is the point at which such reversal takes place. It is, in fact, the null-point of the double spiral. Chromonemata with this type of coiling may often be seen in the illustrations of several recent cytological papers (Maeda 1930, Sax 1930, Eichhorn 1931, Latter 1932) ; but its significance does not appear to have been noted by any one till now.

The form of chromosomes is largely determined by the position of the constriction. In *Allium* these constrictions are usually median, with a few chromosomes having sub-median and sub-terminal constrictions. The chromosomes bend at the constrictions with the result that they assume V, U, and J forms. The constriction is a zone of variable width. It is either narrow or wide, being bridged over by two chromatic strands. These strands have been termed " achromatic bridges " by Robertson (1916) and others ; but as these are the chromatic threads which pass from one arm of the chromosome to the other, it is more appropriate to designate them as " chromatic bridges."

In *Allium,* chromosomes with median constrictions usually show three
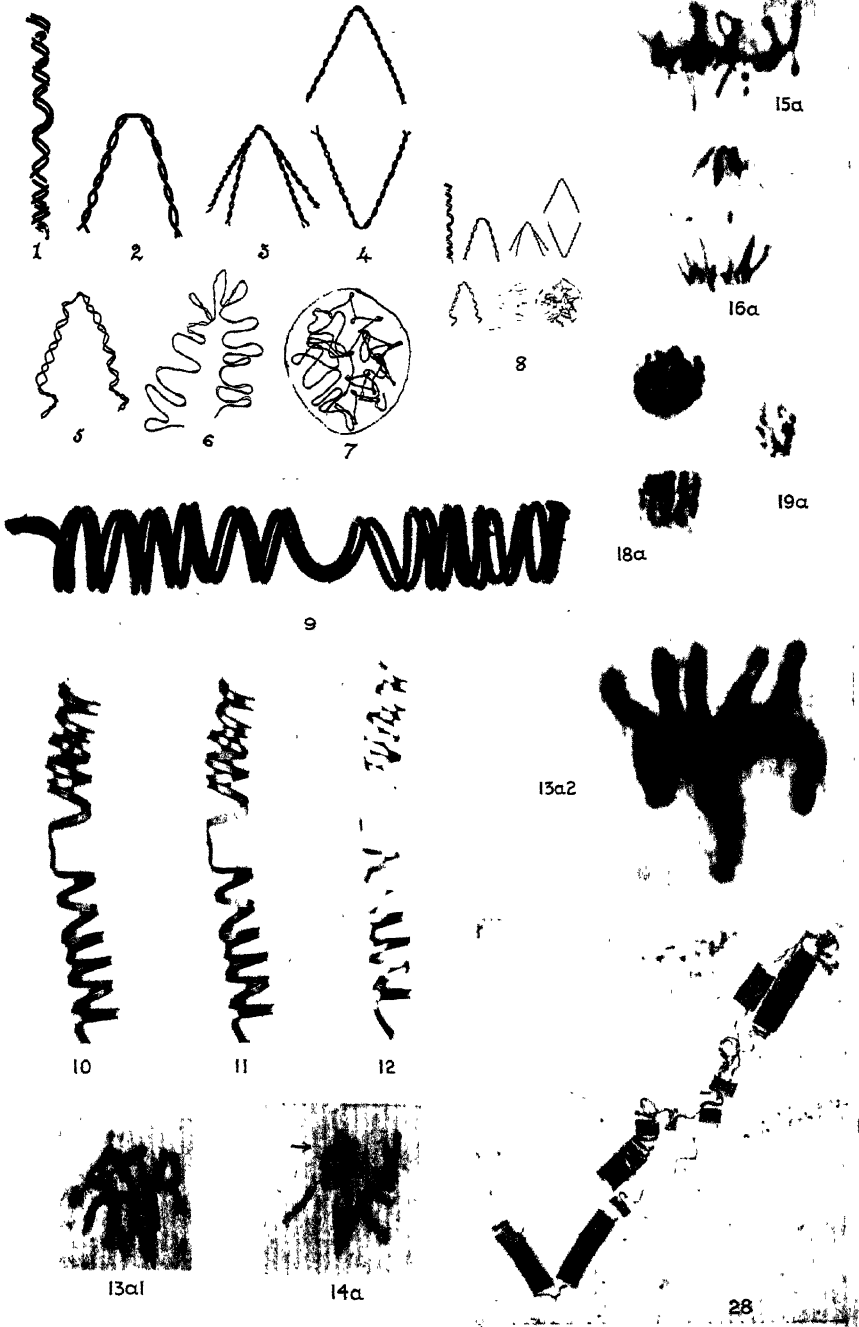
or four twists on each arm, while in those with sub-median constrictions there are six twists on the long arm and two on the short arm. Fig. 13, pl. II, shows chromosomes of all grades of twisting. This is an exact reproduction of a metaphase group, a photomicrograph of which is seen in fig. 13a, pl. I. The spindle fibres appear at about this time and the chromosomes show clear indications that although their arms are free, they are held fixed at the equatorial plane of the spindle by fibre attachments at the point of constriction. As soon as each chromosome gets thus fixed, its halves begin to unwind from the ends of the chromosome towards the constriction (figs. 13 and 13b, pl. II). The coiling of the chromonemata being in opposite directions in the two arms of each chromosome, unwinding proceeds in the same direction with reference to the entire chromosome, and consequently separation of the halves is accomplished without placing any strain on the constriction. By this process of unwinding the daughter chromosomes become free. They are, however, held together at the constriction and are connected by denser strands of achromatic material (figs. 13b and 14, pl. II) till their final separation.

Each chromatid now shows a moniliform appearance (fig. 14, pl. II), being composed of closely intertwined threads. The duality of each daughter chromosome at this stage may be verified by the following evidence :—

(1) In preparations which are deeply stained, a lateral view of each chromosome often shows an undulating contour and beaded appearance (figs. 14, 14b, pl. II, and fig. 14a, pl. I). The latter has been mistaken as indicating a chromomeric structure in metaphase chromosomes. There can be no question that the undulating contour and the resultant moniliform appearance would be formed by two intertwined spiral threads.

(2) In less stained preparations these interlacing threads may be seen to enclose pale diamond areas. The arrow mark in fig. 14a, pl. I, points towards a chromosome in which a few such areas may be noted.

Such interlacing chromonemata have been observed in the metaphase chromosomes by Kaufmann (1926), Sharp (1929), and Telezynski (1931), while Hedayetullah (1931) and Perry (1932) have reported a quadripartite structure in each metaphase chromosome, the two threads of each chromatid being parallel and in close proximity to one another.

Anaphase.—The separation of the chromatids commences at the constriction (figs. 15, 15b, pl. II, and fig. 15a, pl. I). At the inception of this process the chromatic bridges of the sister chromatids begin to arch towards the opposite poles of the spindle. These then move farther and farther apart. The process of anaphasic separation of daughter chromosomes has been described as being due to a repulsion of the chromatids ; but the configuration of the anaphase chromosomes as well as the time taken by them to separate, seems to indicate that it is more the result of a " pull " than a mutual repulsion of the separating chromatids. The spindle fibres which are connected to the chromatids at the constriction may, by their contraction, effect the separation of the daughter chromosomes. After the migration

of these to the poles of the spindle, the fibres initiate the formation of a septum at the equator of the spindle.

The structure of the anaphase chromosomes has been much disputed. In my preparations they unmistakably present a twisted structure (fig. 16, pl. II), the clear areas along the axis of each chromosome indicating their duality. They often show terminal indentations or notches (*a* in fig. 16, pl. II). The bifid tip of these in some cases is so wide as to remove any doubt as to their double spiral structure. The moniliform appearance of anaphase chromosomes has been described and figured by several investigators. Taylor's (1925b) observation of a split satellite in an anaphase chromosome of *Gasteria* is conclusive evidence of the duality of these chromosomes.

As the chromosomes approach the poles their arms close up and the coils of the double spiral contract. The intimate association of the matrix with the chromatic threads is clearly seen by minute connecting strands which may be observed to persist until their final separation at the late anaphase (*a* in fig. 16*b*, pl. II). On reaching the poles the chromosomes are clumped together, forming the so-called " tassement polaire " (fig. 17, pl. II). At this stage there is maximum contraction of the chromosomes. The presence of " vacuoles " in the cytoplasm of the cell, though peculiar in actively dividing cells, clearly shows that at this stage there is intense contraction of nuclear material in the interior of the cell.

The transition of the anaphase chromosomes to those of the succeeding telophase does not involve any material transformation of the chromatic constituent of the chromosome, nor is there any actual fusion of adjacent chromosomes as described by some workers. At the tassement polaire stage contraction of the chromosomes is accomplished by the closing up of the coils of the double spiral. In some cases these coils come so near each other that they touch one another. The boundaries of the individual chromosomes can, however, be marked out even at this stage. In some nuclei the projecting arms of some chromosomes may reveal their twisted aspect and forked ends. This stage is, however, of short duration, the clump soon passing by a process of expansion of the coils to the telophase.

Telophase.—The expansion of the coils of the polar clumps marks the beginning of this stage. At the commencement of this process a limiting membrane is established around each group of daughter chromosomes, separating its contents from the surrounding cytoplasm (fig. 18, pl. II). With the organization of the daughter nucleus, the achromatic matrix either decreases its affinity for stains or dissolves and becomes merged with the karyolymph of the nucleus. The chromatic threads would consequently become more distinct and the interlacing aspect of these becomes very pronounced (fig. 18*b*, pl. II). The nucleus gradually increases in size and the expanding coils of each chromosome occupy the peripheral region of the nucleus. The chromosomes now form a wide ring which in polar view shows them as radiating from a common point at or near which their constrictions
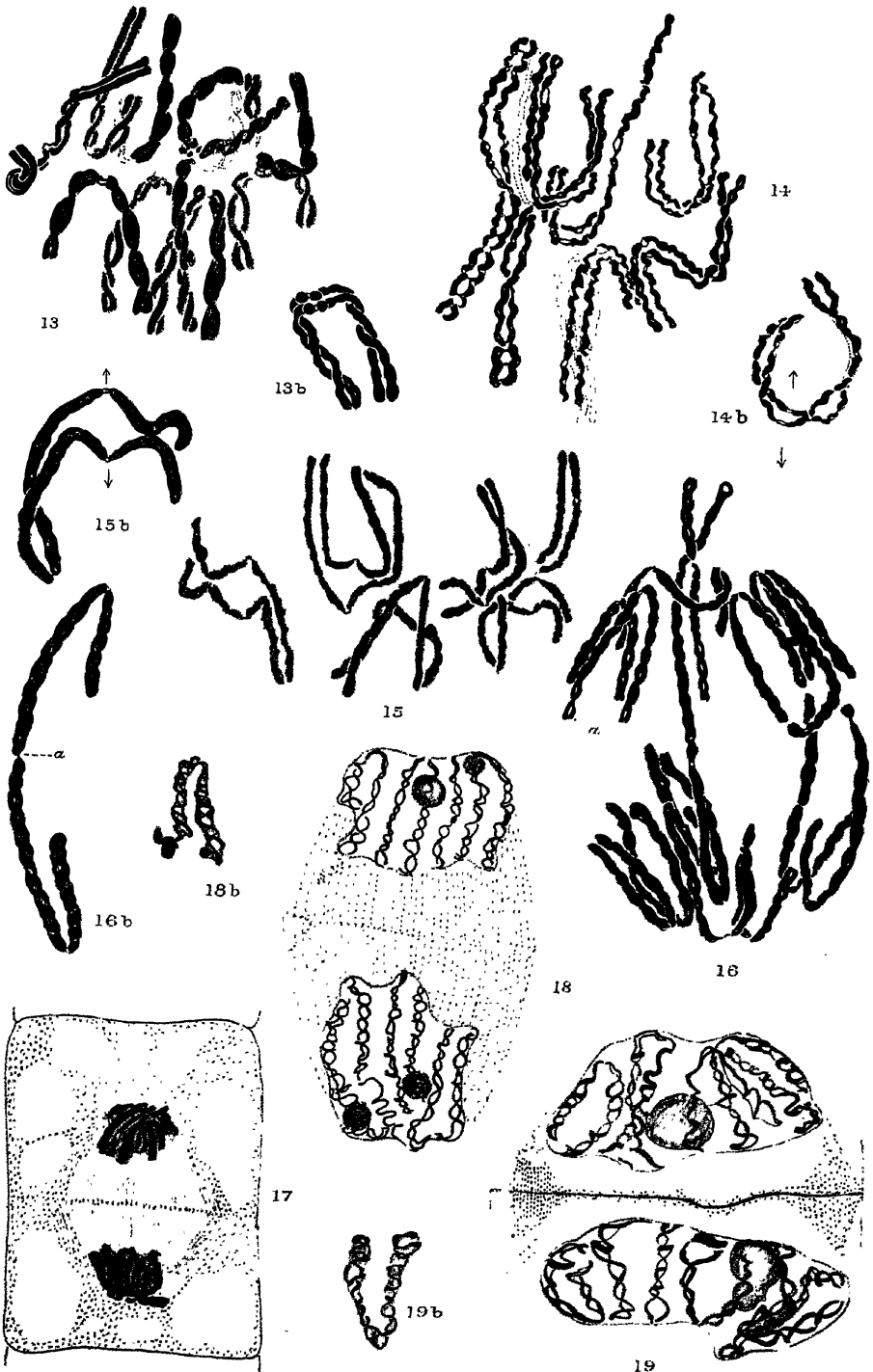
may still be noted in favourable cells (fig. 19, pl. II). Fig. 19a, pl. I, is a photomicrograph of a nucleus in which, besides the spiral structure of chromosomes, the interlacing of the two threads at certain points can be observed so clearly that there can be no doubt as to the duality of chromosomes at this stage.

The telophasic expansion of the coiled chromonemata would account for the so-called alveolar appearance of chromosomes. If a closely compact double coil is subjected to expansion, the separation of the adjoining loops of the coil would, in side view, show clear areas enclosed by these loops. There is no doubt that these areas have been interpreted as alveoli by early investigators. As expansion proceeds these areas diminish in size (figs. 20 and 21, pl. III), and at the late telophase (fig. 21) the two threads are so closely approximated that there is hardly anything to bring out their dual structure. Prof. Gates suggests that this expansion or extension of the chromosomes in length is the result of mutual repulsion of adjacent coils due to a superficial electrical charge. The telophasic expansion commences at the ends of chromosomes (fig. 20b, pl. III). The expanding ends of these are often seen to push forward the nuclear membrane towards the septum (fig. 18, pl. II). The expansion of the chromosome does not diminish the number of twists in each; but the coiled aspect of the dual threads is lost and a twisted structure is formed instead. The nuclear membrane limits the space for linear expansion of the coils and so they are thrown into folds (fig. 20b, pl. III).

Anastomosing strands are often reported as originating between chromosomes at this stage of nuclear activity. These are assumed to connect adjoining chromosomes, developing ultimately the reticulum of the resting nucleus. In my preparations in which the spiral structure of chromosomes was clear in all stages, no such anastomoses were present and the twisted chromonemata were seen to persist as independent threads in the late telophase and succeeding stages.

The nucleoli make their appearance at this stage. These have not been observed to have connecting strands with chromosomes. They show marked affinity for basic dyes. Fusion of two or more nucleoli into one or fragmentation of one into two or more appear to be common occurrences in actively dividing cells.

Interphase and Resting Stages.—In rapidly dividing cells mitoses often follow with such rapidity that the telophase chromosomes pass to the prophase without a definite period of rest; but in most cases the cells pass to the quiescent stage before beginning the next division. The telophasic expansion stops before reaching the maximum and the coils begin again to contract. The maximum expansion of the coils and elongation of the threads are, however, accomplished in the resting stage. The metabolic activities of the nucleus are no doubt at a maximum at this stage and the chromosomes become fully equipped here for the succeeding division.

The chromonemata are thus drawn out to their full length at the resting

stage. The structure of the resting nucleus has been interpreted in various ways by different investigators. The threads are described as single, forming a reticulum by some workers; others have observed them as chromomeric, and a few investigators have regarded the threads as maintaining their dual structure and persisting as non-anastomosing threads. As shown above, the duality of the late telophase chromosomes has been completely obscured by the full extension of the double coil (fig. 22, pl. III). The granular appearance which the nucleus may show at the resting stage is apparently due to the twists and bends of the zigzag threads (fig. 22*b*, pl. III).

Prophase.—When the quiescent nucleus is to commence its mitotic activity, the twisted chromonemata tend to assume a more peripheral position in the nucleus (fig. 23, pl. III). At this stage a clear halo is seen in an optical section of the nucleus. This appearance is due to the formation of a hollow sphere by the migration of the threads to the periphery of the nucleus, leaving the nucleolus within the chamber thus formed. The threads then begin to contract (figs. 24–27, pl. III). This contraction is along the axis of each thread of the chromosome, making it shorter and thicker as well as a closer approximation of the successive coils in each chromosome. The chromosome outlines would become more marked out and the diamond areas which disappeared at the late telophase come again to view (figs. 26, 26*b*, pl. III). The achromatic matrix of the chromosome reappears and the characteristic coiling of the chromonemata becomes distinct. At the late prophase the nuclear membrane disappears, the split for the succeeding mitosis is commenced, and the chromosomes arrange themselves at the equator of the spindle, to get fixed, to unwind, and to separate.

IV. Discussion.

In tracing the history of the somatic chromosomes of *Allium* the chromatic constituent of each chromosome has been observed to persist as two interlacing threads in all stages. An examination of the chief theories on chromosome structure would show that the divergence of opinion is due to faulty interpretation of the twisted aspect of these threads under different degrees of expansion and contraction to which they are subjected in the different mitotic phases.

(*a*) *The Alveolation Theory.*—This view of chromosome structure was foreshadowed by some observations of van Beneden's, but it was worked up into a theory by Grégoire (1903) and his school of cytologists. According to this view, the chromosome is built up of a homogeneous substance which maintains an individuality in its history. At the telophase each chromosome assumes a honeycombed structure by the appearance of numerous vacuoles (alveoles) in it. Lateral anastomoses then connect the adjoining chromosomes and form a " network of networks," which is the reticulum of the resting nucleus. At the prophase the chromatin material of each
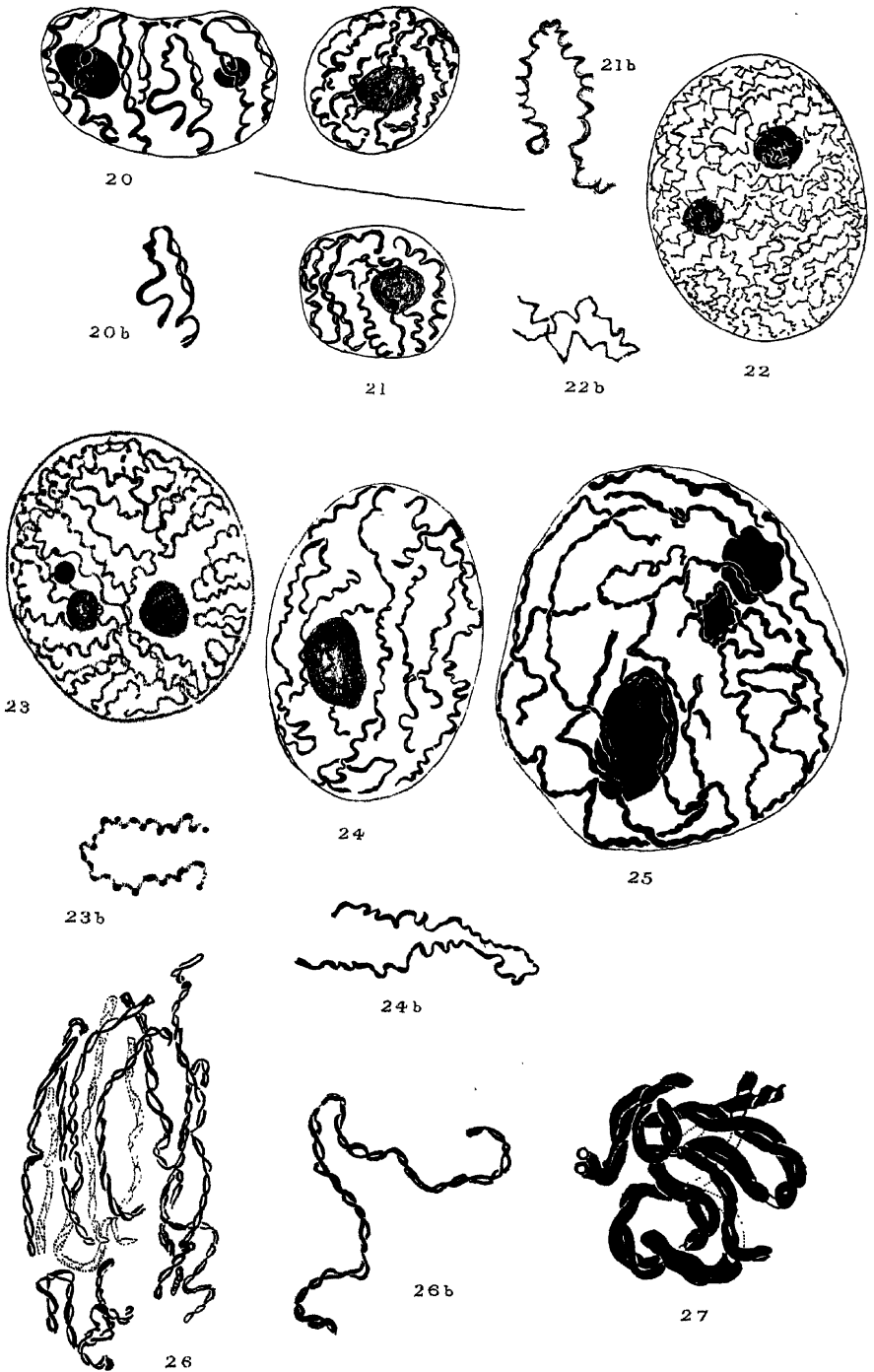
chromosome condenses into a very irregular zigzag thread, which by gradual straightening and thickening forms the metaphase chromosome.

The alveolar appearance of chromosomes has been observed in both plants and animals by numerous investigators. Notwithstanding the observations by Grégoire and Wygaerts (1903) of the origin of these vacuoles in the metaphase chromosomes of *Trillium,* and in the anaphase chromosomes of *Allium* by Merriman (1904), Lundegårdh (1910, 1912*b*), and Němec (1910), these alveoles have usually been seen to appear at about the time when the chromosomes recover after the polar clumping. At this stage the vacuoles are not only median but also near and against the periphery. Such irregular distribution of these at the telophase has been advanced as an argument by Sharp (1913, 1920) to disprove the claim made by Lundegårdh (1910, 1912), Fraser and Snell (1911), Fraser (1914), and Digby (1914, 1919) that median vacuolization at this stage results in splitting the chromosomes. Sharp, on the other hand, agrees with Grégoire and Wygaerts (1903), Grégoire (1906), Němec (1910), and Müller (1912) in considering that while the telophasic vacuolization results in developing the network of the resting nucleus, the true splitting of the chromosomes is initiated in the threads of the early prophase by small alveoles which appear along the axis of the thread.

The presence of spiral threads in chromosomes during the telophasic transformation was observed by Bonnevie (1908, 1911), who reported an endogenous origin for such threads in *Allium, Ascaris,* and *Amphiuma,* and De Horne (1911) asserted that each chromosome in *Salamandra* and *Allium* is represented at telophase by two interlaced spirals. The so-called alveolation is responsible, according to many workers, in transforming the homogeneous substance of the chromosome into zigzag or spirally coiled threads. There is no doubt, therefore, that the spiral structure of the chromosomes was observed in some phases, even by those who believed in the alveolation theory.

When the coils of a double spiral are drawn out, or when such coils contract after maximum expansion, clear areas bounded by the loops of the coil may be seen along its axis. In the mitotic history of chromosomes there is an evident expansion in them at the telophase and contraction at the prophase. The double spiral structure of these would thus account for the appearance of clear areas which are observed at these stages. The figures illustrating the papers of most of the investigators referred to above afford clear indications that the areas bounded by the threads of the double spiral have been interpreted by them as alveoles. Grégoire's (1906) figs. 17 and 18, Sharp's (1913) figs. 13 and 14, Sarbadhikari's (1924) figs. 22 and 27 are a few of the many which may be cited in support of this view. Sharp (1929), who had been a staunch supporter of this theory, has abandoned it and has admitted that " the data now at hand are in full harmony with the view that the more chromatic constituent of the somatic chromosome maintains the form of a chromonema, double in some cases at least, throughout the mitotic

cycle, and is accompanied by the less chromatic constituent as a matrix at most if not all stages. The telophasic transformation does not involve an actual ' alveolation ' of the chromosome; hence this term should be abandoned."

(b) *The Chromomere Theory.*—The second important theory of chromosome structure is that originated by Pfitzner, who in 1880 suggested that the chromosome is made up of a row of granules embedded in an achromatic or less chromatic matrix. These granules have since then been termed " Pfitzner's granules." Fol (1891) first employed the term " chromomere " as equivalent to a chromosome; but later this has come to be used as a synonym to these granules. Wilson (1896) found still smaller bodies composing a chromomere, and to these smallest visible parts, which are assumed to compose a chromomere, Eisen in 1900 gave the name, " chromioles."

Strasburger (1907, 1911) found definite morphological units or chromomeres arranged in a series along the thread. Digby (1912) stated that in *Primula* the chromosomes are formed by the stringing together of homogeneous beads of chromatin. Wenrich (1916) demonstrated the presence of such granules in *Phrynotettix*. Sands (1923) obtained, by the acetocarmine method of treating the material, preparations in which he found chromomeres which are variable in size, shape, and number. Belling (1928, 1931), working on Liliaceous plants by the acetocarmine method which he introduced, has not only observed chromomeres but has even made estimates of their number in the nucleus.

The existence of such morphological units (chromomeres) arranged in a series along the thread was, however, denied by Grégoire ·and Wygaerts (1903), Martins Mano (1904), Grégoire (1906), Sharp (1913), Bolles Lee (1920).

The proponents of the chromomere theory assume that the chromomeres are arranged in a linear series in the threads especially of the resting stage. The chromomeres split along the axis of the thread, giving rise to two parallel chromomeric threads. But in the early prophase the chromatic threads exist as interlacing bands (Janssens 1901, Wilson 1912, Wenrich 1916, Newton 1924, and several others), and not parallel threads as one would naturally expect according to this view. The interlacing aspect of the late telophase chromonemata has been observed by Kaufmann (1926) in *Tradescantia*, Sharp (1929) in *Allium* and other plants, Telezynski (1930, 1931) in *Tradescantia* and *Hæmanthus*, Smith (1932) in *Galtonia*, as well as in this paper. There is no doubt, therefore, that the chromosomes exist as intertwined threads at the intermediate resting stage. The granular appearance of the resting nucleus should, therefore, be either the result of a material transformation of these threads into beaded structures or an optical illusion due to the interlacing nature of the threads. Kaufmann (1926) observed such granules and interpreted them as representing " only doubleness or greater amount of thread surface." Smith (1932) thinks that these granules " correspond to points at which the chromonemata of each chromosome are

in contact with each other." O'Mara (1933) explains this granularity as "due to the fact that only the crests of the wavy chromosomes are in sharp focus."

There is no evidence to show that the chromonemata undergo any structural change at the resting stage. They are so thin that they hardly come within the range of visibility. With the present resolving power of our optical instruments, such twisted threads will only appear as single or double row of granules as their crests or bulges respectively are in sharp focus. The regions of the thread which are not in focus will be seen as hazy gaps between these granules giving the threads a beaded appearance as already explained. It is also possible that the granular appearance may be due to the "zigzagging" of the chromonemata at the resting stage. Images of portions of these threads, which bend and overlap, will be seen as linear series of granules. As will be shown later, such images have been misinterpreted as chromomeres by Hedayetullah (1931) and Perry (1932).

Again. as Sharp (1913) has pointed out, on theoretical grounds also, these granules cannot be considered as morphological units as they are far too few for the present requirements of the Mendelian theories. The so-called chromomeres are, therefore, the misinterpreted images of portions of the twisted chromonemata and not structural units of chromosomes.

(c) *Chromonema Theory.*—Baranetzky in 1880 found a spiral structure in the meiotic chromosomes of *Tradescantia virginica.* A finely coiled thread was noted by Janssens (1901) in the telophase chromosomes of the spermatogonia of urodeles. Bonnevie (1908, 1911) described a spiral chromatic thread in the chromosomes of *Ascaris, Allium,* and *Amphiuma ;* but she supposed that it arose endogenously in the chromosome, whereas it is now clear that the chromonemata are always derived by a split in the previous chromonema. De Horne (1911) observed the telophase chromosomes of *Salamandra* and *Allium* to be composed of two interlacing spirals. Vejdovský (1912) noted similar threads in *Ascaris* and he gave the name "chromonema" for each thread. Kaufmann (1926) found the somatic chromosomes of *Tradescantia* to be composed of a chromatic substance which exists in the form of a pair of unbroken intertwined spiral threads. Sharp (1929), Kuwada (1921, 1926, 1927), Sakamura (1927), and Telezynski (1931) have furnished cogent evidence in support of the chromonematic structure of chromosomes. Hedayetulla (1931) in *Narcissus,* Janaki Ammal (1932) in *Nicandra,* Perry (1932) in *Galanthus,* Smith (1932) in *Galtonia,* and recently O'Mara (1933) in *Lilium* have reported the presence of distinct chromonemata in the chromosomes examined by them. In addition to these, the spiral structure of chromosomes has been observed in certain stages of the mitotic cycle by a large number of investigators. There is convincing evidence, therefore, that the chromatic constituent of the chromosome exists as spirally coiled threads, the chromonemata. These threads have been observed to persist as dual structures in the mitotic history of somatic chromosomes by Kaufmann (1926), Sharp (1929),

Telezynski (1931), Smith (1932), and O'Mara (1933); while among recent writers Kuwada (1926), Hedayetullah (1931), and Perry (1932) have described the chromosomes as chromonematic at certain stages and chromomeric at others. Kuwada has offered an ingenious suggestion as to the origin of spirality in the normally chromomeric threads. According to him, the chromonema is comparable to a rubber thread in which numerous balls (chromomeres) are embedded. When the thread contracts, the balls would slip from the original line of alignment. He assumes the chromonema to be straight (with the chromomeres as far apart as possible) at the prophase, becoming a spiral at the metaphase by the contraction of the thread. As already stated, the chromonemata exist as interlaced threads at the prophase and mere contraction of these would not be sufficient to develop independent spiral structures in metaphase chromosomes. Hedayetullah (1931), in his fig. 16, shows an advanced telophase nucleus in which unwinding of the chromonemata is in progress. In figs. 18–25 (late telophase and resting nuclei) the chromonemata are represented as chromomeric and are shown as parallel threads. At the prophase (fig. 29) he says, " one can see clearly that each chromosome band is composed of two coiling and interlaced chromatic threads supported on a less chromatic matrix." He assumes from this that unwinding and rewinding processes are taking place during the passage of the threads from telophase to prophase. A coil can unwind or two parallel threads can become twisted together only if there is a fixed point towards which or from which unwinding or twisting respectively can take place, and provided there is room for the threads to rotate. The chromatic threads in the somatic stages from telophase to prophase are very compactly arranged in the nuclear chamber and they are not fixed at any point. It is, therefore, quite unlikely that the chromonemata can unwind or recoil at these stages. The threads, on the other hand, are seen to maintain their twisted structure in these phases and I have not been able to see the double row of chromomeres as figured by him. Smith (1932) has also reported his inability to observe the double row of chromomeres described by Hedayetullah. Miss Perry (1932), in tracing the history of the somatic chromosomes of *Galanthus* from the telophase to the prophase through the resting stage, has observed the dual threads persisting as interlacing structures. At the latter phase, however, she has noted a few chromosomes which show a double row of chromomeres. She also has not made it clear how the interlacing threads become parallel and assume chromomeric appearance.

It is clear from these that the so-called alveoles and chromomeres are merely optical illusions due to the double spiral structure of chromosomes. The fundamental structure of chromosomes as seen in *Allium* is illustrated by photographs of wire models in figs. 1–8, pl. I. Fig. 1 shows the winding of the two chromonemata in opposite directions in the two limbs of the chromosome. Figs. 2 and 3 are models of metaphase chromosomes before and after the unwinding. Each daughter chromosome of fig. 3 is repre-

sented as being composed of two twisted threads, because the spiral split which originates in each thread at the late prophase is completed during the process of unwinding, and the duality of each daughter chromosome becomes evident at this stage. Fig. 4 shows the anaphase chromosomes. The moniliform appearance and undulating contour of these, though schematic, are very much like those usually met with in anaphase chromo-somes of well-fixed material. The telophasic expansion of the double coil as a possible explanation of the alveolar appearance of chromosomes at this stage is represented in fig. 5. Fig. 6 shows the zigzag threads of the late telophase in which the duality of each chromosome is obscured by the expansion of the double coil. How a confused tangle of twisted threads may give a reticulate as well as a chromomeric appearance in the resting stage of the cell is shown in fig. 7. Fig. 8 is a photograph of models 1–7 on a reduced magnification. As this magnification is insufficient, the twisted threads do not come within the range of clear visibility to bring out their dual structure or twisted aspect.

While taking photographs of these models, the peculiar images which a double spiral throws on the ground-glass screen by slight variation of focus of the lens, gave a clue to the so-called anastomosing strands which are often reported in the telophase and resting nuclei. By a simple manipulation of illumination and variation of focus it is easy to get from a double coil, as shown in fig. 9, appearances which are very misleading and at the same time very suggestive. Figs. 10–12 are some of the appearances which may be thus obtained.

One can easily see from these that the different appearances presented by chromosomes during the mitotic cycle are not due to any variation in the plan of their construction, but they reflect only the limitations in the resolving power of the optical instruments now at our disposal, and our imperfect knowledge of the optics and mechanics in relation to a double spiral structure.

V. Division of Chromosomes.

The genetic continuity of chromosomes is possible only if the daughter chromosomes formed in mitosis are identical quantitatively and qualitatively. Notwithstanding the observations of Bolles Lee (1920) that doubling of chromosomes is brought about by their transverse segmentation at telo-phase, and of Marten's (1922) view of bipartition of prophase threads across the spiral, there is general agreement that identical daughter chromosomes are formed in mitosis by the longitudinal cleavage of the mother chromo-some. There is, however, much diversity of opinion as to the time at which such duality occurs as well as the mode of fission.

(a) *Time of Cleavage.*—Flemming in 1880 observed the chromosomes at the equatorial plate as double and suggested that the daughter chromosomes arise at the metaphase by a longitudinal splitting of the mother chromosome. Roux (1883) pointed out that the longitudinal cleavage is indicative of the

differential character of the chromosome along its length. Grégoire and his school considered that this splitting occurs at the prophase, being brought about by the fusion of a longitudinally aligned central series of alveoles. Strasburger (1911), on the other hand, assumed that the cleavage is initiated by the division of chromomeres which are arranged in a series along the thread at the prophase. Müller (1912) suggested that the portions of the thread between the chromomeres split first, completing the cleavage of the thread later, by the fission of the chromomeres. Gates (1912) and Sharp (1913) believed that the splitting is a prophasic phenomenon.

Fraser and Snell (1911) expressed the idea that in *Vicia* the chromosomes undergo axial vacuolization at the telophase and concluded that since they are connected by anastomoses, the general enlargement of the nucleus at this stage produces a strain sufficient to pull the split halves apart along the line of vacuoles. De Horne (1911) concluded, from his work on *Salamandra* and *Allium*, that each chromosome becomes completely split at the anaphase. A convincing proof of the " pre-resting " duality of somatic chromosomes is furnished by the presence of a more or less split satellite appended to the anaphase chromosomes of *Gasteria* (Taylor, 1925b). The telophasic duality of chromosomes has been recorded by Fraser and Snell (1911), Granier and Boule (1911), Schustow (1913), and Sarbadhikari (1924) among others, while Merriman (1904) and Taylor (1925a) have reported the anaphase chromosomes as structurally double. The origin of the split has now been definitely ascertained as originating in the metaphase (or slightly earlier) of the preceding somatic cycle (Kaufmann 1926, Sharp 1929, Telezynski 1931, Hedayetullah 1931, Perry 1932, and Smith 1932). Gates (1932) has surveyed the advance made in our conception of this much-disputed problem in the following words : " It appears clear that the chromonema undergoes a straight longitudinal split at or just before the metaphase, while the paler staining matrix of the chromosome remains unchanged."

My work on *Allium* has also shown clearly that the split originates at the preceding pro-metaphase. There are, however, a few investigators who still refuse to believe that such splitting can originate at any stage earlier than the prophase of the same somatic division. In the chromosome studies of *Nicandra physaloides*, Janaki Ammal (1931) observed a persistent spiral structure in all mitotic stages ; but clear evidence of split has been seen by her only in the spireme of prophase. Darlington, in his " Recent Advances in Cytology " (1932, p. 47), considers all evidence in favour of the anaphase or telophase splitting as valueless, and has argued that such a view is incompatible with three series of observations. Firstly, as a spiral structure has been observed in anaphase chromosomes, the supposed split would cut across the spiral. But as the split occurs at the pro-metaphase, the anaphase chromosome is already made up of two interlacing chromonemata. The cleavage being along each thread, the split would never cut across the spiral as Darlington quite un-necessarily assumes. His second argument is not clear. He says : " A split spiral is found at the prophase, and there should be two independent

spirals side by side if the chromosomes were already longitudinally split at the preceding division." The chromonemata of each chromosome, in fact, persist as interlacing threads in all stages of the mitotic cycle, till their final separation at the following metaphase. At the prophase, therefore, only a split spiral and not two independent spirals will be seen. And thirdly, he says, " the chromosomes are always single at the earliest prophase of meiosis." This statement is contrary to the observations of competent investigators such as Robertson (1916) and McClung (1928), not to mention others. It is therefore highly questionable whether Darlington's supposed distinction between meiosis and mitosis, viz. the suppression of an early prophase split in the former, is based on adequate evidence.

(b) *Mode of Cleavage.*—The manner in which cleavage is initiated in each chromonema is still unknown. No external factor has yet been observed to play any definite and important part in the process. The primary act of division is therefore assumed to be an autonomous activity on the part of chromosomes. Earl's (1927) view of the gene thread as the basis of chromonema appears to fit in with my observations, and it is highly probable that the particles (genes) which compose the thread are arranged spirally along its axis. The phenomenon of cleavage seems to be associated with the growth of the chromonema, which reaches maximum at the late prophase.

(c) *Line of Cleavage.*—The division of chromosomes is longitudinal in the parent chromonema. The mode of origin of the split as well as the increase in the number of twists of the daughter chromosome seems to indicate that the line of cleavage is not straight along the axis of the parent chromonema but takes a spiral course in its formation. Careful examination of the number of twists on each chromosome before unwinding, and that on each daughter chromosome just after cleavage is completed, has shown that the daughter chromosomes at metaphase have approximately three or four times the number of twists of the parent chromosome. If the line of cleavage is straight along the axis of the thread, the number of coils should be the same in both the parent and daughter chromosomes. This increase is due to the fact that the cleavage of the thread has a spiral course along its axis.

Thus, the spiral nature of the chromonema appears to be a distinct character of chromosomes. It originates as a spiral and persists as such in its history. The phenomenon of coiling is perhaps associated with the conservation of space, as Kaufmann (1926) has suggested, and it is the natural result of the arrangement of the particles composing the thread in a spiral manner. This mode of origin of the chromonemata is comparable to the development of spiral vessels in plants (Barkley 1927). It may be mentioned here that even in spiral vessels there is reversal in the direction of coiling at regular intervals. The threads of the vessels may either be single or get split longitudinally presenting a double spiral structure at certain regions of the vessel. These structural peculiarities of the vessels, presenting such close analogy to the spiral structure of chromosomes, are clearly seen in fig. 28, pl. I, which is a photomicrograph of a vessel of

Elettaria, from a preparation of Mr. P. J. Gregory, Research Student of this Department.

(*d*) *Mode of Separation.*—The dual threads of each chromosome remain twisted round each other in all somatic phases. A process of unwinding should, therefore, naturally precede their separation. Although such interlacing threads have been observed even at the early metaphase by numerous workers, no satisfactory explanation has yet been offered regarding the mode of separation of these threads. The only one worth mentioning is that suggested by Kuwada (1927). According to his interpretation, the two chromonemata of each chromosome coil in such a manner that for each turn of the spiral there is a twist of the two threads about each other in the opposite direction. A double spiral of this type cannot normally originate by the longitudinal fission of the spirally coiled parent chromonema. Kuwada's suggestion is thus untenable.

The mode of coiling observed in *Allium* appears to be designed to facilitate easy separation of the twisted threads. The winding being in opposite directions on the two arms of each chromosome, the component threads can separate by a simple process of unwinding if the chromosome is held stationary with reference to the null point. In the history of the chromosomes there is no stage when they are fixed except at metaphase. As pointed out in the earlier part of this paper, the chromosomes get fixed to the equatorial plate and then unwind from the ends towards the constriction. The two arms rotate in the same direction and in doing so the threads separate.

In tracing the history of the chromosomes of *Allium* the chromatic constituent has been observed as two interlacing threads in all phases. The various appearances presented by the chromosomes are due to the expansion and contraction of these interlaced threads. At no stage in their history are they seen as single straight threads which by linear contraction give rise to closely coiled spirals as assumed by Bridges (Alexander 1928), Kuwada (1927), and others. The intertwined threads of the early prophase by linear contraction give rise to shorter and thicker chromonemata, still twisted round each other. This contraction reduces the number of twists in each chromosome, so that at the metaphase the threads are shorter and thicker and the twists are fewer. The chromonemata are thus coiled in an orderly and definite manner, and the point at which reversal takes place appears to be determined by genetical factors. This reversal is, however, indispensable in the mechanics of mitosis.

VI. Summary.

From an investigation of chromosome structure in the root-tips of various species of *Allium*, the following conclusions are drawn :—

(1) The chromatic constituent of each chromosome persists throughout the mitotic cycle as two twisted chromonemata

(2) The twisting of the chromonemata is in opposite directions in the two arms of the chromosome, the null point being its attachment constriction.

(3) At the metaphase each chromosome is held fixed in the equatorial plate by the spindle fibre attachment at the constriction, and the halves unwind from the ends towards the constriction. The cleavage, which takes a spiral course along the thread, originates at the late prophase, and is completed during the unwinding of the daughter chromosomes at metaphase.

(4) The series of alterations undergone by the chromosomes through the successive phases of the mitotic cycle are summarized in the preliminary statement at the beginning of this paper.

(5) The alveolar and chromomeric appearances of chromosomes are shown to be optical effects of the twisted chromonemata under different degrees of expansion and contraction, to which they are subjected in the different mitotic phases.

I am indebted to the Government of H.H. The Maharajah of Travancore for affording me facilities for undertaking this work in the University of London, and I wish to express my gratitude to Prof. R. Ruggles Gates, F.R.S., for valuable suggestions and criticisms throughout the progress of this investigation.

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EXPLANATION OF PLATES.

All figures of Plates II and III were drawn at table level, with the aid of a Reichert camera lucida at a magnification of × 3,400 using a Busch $\frac{1}{13}$-inch oil immersion, N.A. 1·30, aplanatic condenser N.A. 1·40, and Zeiss ocular × 20, except for fig. 17, which was drawn with ocular × 10. Special care was taken to obtain critical illumination. All "a" figures arranged in Plate I are photomicrographs, the magnification of which is only × 700.

PLATE I.

Figs. 1–12.—Wire Models. *Vide* text.

Fig. 13a¹.—Photomicrograph of chromosomes at metaphase. *Vide* description of fig. 13 (pl. II).

Fig. 14a.—Photomicrograph of cell shown in fig. 14 (pl. II).

Fig. 15a.—Photomicrograph of cell shown in fig. 15 (pl. II).

Fig. 16a.—Photomicrograph of cell shown in fig. 16 (pl. II).

Fig. 18a.—Photomicrograph of cell shown in fig. 18 (pl. II).

Fig. 19a.   Photomicrograph of cell shown in fig. 19 (pl. II).

Fig. 13a².—Photomicrograph of a metaphase group of chromosomes of *A. cepa* fixed in Medium Flemming modified with uranic acid in place of osmic acid. The spiral chromonemata are seen in a few chromosomes. The magnification of this is twice that of the above.

Fig. 28.—A spiral vessel of *Elettaria*. The threads of the vessel are single at some regions and double at others. The direction of coiling is reversed at regular intervals. The formation of diamond areas when the double spiral is extended is seen at the right-hand top corner of the figure.

PLATE II.

Fig. 13.—General appearance of early metaphase chromosomes of *A. sativum* fixed in medium Flemming. The chromosomes are arranged at the equatorial plate and unwinding has commenced at the ends of a few chromosomes.

Fig. 13b.—Single chromosome of No. 13, in which unwinding has commenced on the right arm.

Fig. 14.—*A. ascalonicum*, fixed in La Cour's 2B. The daughter chromosomes are completely free except of two chromosomes. They present a "chromomeric" appearance at this stage due to the two chromonemata of each being tightly twisted.

Fig. 14b.—Single chromosome of No. 14.

21—2

Fig. 15.—*A. ascalonicum*, in which anaphasic separation has commenced. The attachment constrictions of sister chromatids arch towards the opposite poles of the spindle. Each of these shows the dual structure and twisted aspect.

Fig. 15*b*.—Single chromosome of No. 15. The arrows point towards the poles of the spindle.

Fig. 16.—Anaphase chromosomes of *A. ascalonicum*, showing moniliform appearance and twisted aspect of the chromosomes. The occasional forked ends are shown at *a*.

Fig. 16*b*.—Single chromosome of No. 16. Besides the twisted structure of the arms, the achromatic strand which persists till the final sepaiation of the daughter chromosomes is seen at *a*.

Fig. 17.—The " tassement polaire " stage of *A. cepa*, fixed in medium Flemming in which uranic acid was used in place of osmic acid. The clear " vacuoles " in the cytoplasm of the cell are indicative of the contraction of the nucleus at this stage. The septum formation is not yet complete.

Fig. 18.—The early telophase nuclei of *A. ascalonicum*. The expanding ends of chromosomes are seen to push forward the nuclear membrane towards the septum. The double spiral structure of chromosomes is clearly made out at this stage.

Fig. 18*b*.—Single chromosome from a nucleus at this stage. The interlacing aspect of the threads and forked ends are clearly seen in it.

Fig. 19.—Mid-telophase chromosomes of *A. cepa*, var. Bedfordshire Champion, fixed in La Cour's 2B (uranic acid was used in place of osmic acid). The diamond areas become narrower by the expansion of the coils. " Zigzagging " may be seen at the ends of some of the chromosomes.

Fig. 19*b*.—Single chromosome of No. 19. Though the duality and interlacing structure are clear, the zigzag formation is more prominent at the ends of the chromosome.

PLATE III.

Fig. 20.—A telophase nucleus of *A. ascalonicum*. The diamond areas, though clear near the constrictions of chromosomes, are obscured at their distal ends.

Fig. 20*b*.—Single chromosome of No. 20, to show the forked ends.

Fig. 21.—The late telophase nuclei of *A. ascalonicum*. The duality of the chromosomes is almost obscured. The threads are apparently single.

Fig. 21*b*.—Single chromosome of No. 21.

Fig. 22.—Resting nucleus of *A. ascalonicum*. The " granular " threads are not seen to form a reticulum.

Fig. 22*b*.—A portion of a zigzag thread from No. 22.

Fig. 23.—Early prophase nucleus of *A. porrum*, fixed in medium Flemming. The threads present a granular appearance, but these " granules " are only images of regions of the thread which overlap in zigzag formation.

Fig. 23*b*.—Single chromosome of No. 23.

Fig. 24.—Early prophase nucleus of *A. ascalonicum*. The twisted threads begin to show narrow diamond areas. The chromosomes are seen to stretch from one end of the nucleus to the other.

Fig. 24*b*.—Single chromosome of No. 24.

Fig. 25.—Mid-prophase nucleus of *A. porrum*, fixed in medium Flemming. The zigzag threads are more straight. The interlacing aspect is brought out more clearly by the contraction of the threads.

Fig. 26.—Late prophase chromosomes of *A. ascalonicum*. The twisted chromosomes with reversal of direction of twisting at the constriction point are shown.

Fig. 26*b*.—A single chromosome between Nos. 25 and 26. The diamond areas and the characteristic twisting are seen in it.

Fig. 27.*—Late prophase chromosomes of *A. cepa*, fixed in Carnoy's fluid. The chromonemata are stouter and shorter than in No. 26.

* This is drawn from a longitudinal section of a flower of *A. cepa*.

XVII.—A SIMPLE MEDIUM-POWER APPARATUS FOR DIRECT 535.822.3. MICRO-PROJECTION.

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(Department of Pathology, University of Edinburgh.)

One Text-Figure.

In view of the interest that is at present taken in methods for the direct projection of microscopic slides an account is given below of a simple and comparatively inexpensive assembly which has proved very efficient for medium-power work.

The paramount difficulty in direct projection lies in the provision of a sufficient intensity of reflected light from the projected image, and every effort must be made, therefore, to ensure that as little wastage as possible takes place between the source and the eye of the observer. This implies not only a source of very high intrinsic intensity (in practice the carbon arc is the only source of real service) but also a very efficient collimating system, a first-class substage condenser giving an image of the source just large enough and no larger, as high an aperture objective and as low a total magnification as possible, and, finally, a screen of as high reflecting power as can be obtained.

In the present apparatus the source is a clock-controlled carbon arc taking 5 amperes, A (fig. 1). No doubt a lamp of higher current consumption used with an optical system giving less enlargement of the light source might yield a rather higher intensity, but the limiting factor in this is the heat production and resulting danger to stained specimens. The image of the positive crater is enlarged to the required size by the bullseye, B. This is a Watson-Conrady achromatized aplanat and is the most expensive single part of the assembly. It is, however, definitely superior to the Nelson bullseye, which, none the less, can be used with fair results. Between the bullseye and the microscope is the large water trough, C. This rather cumbersome portion might well be replaced with two sheets of Chance Calorex glass immersed in a much thinner cooling trough.

The arrangement of the microscope in the apparatus illustrated is rather unusual and was necessitated by local conditions. The projector is situated just in front of the seats of the lecture theatre, alongside the epidiascope, and the receiving screen is hung at a moderate downward slope at the back of the lecturer's platform. The level of the centre of the screen is some feet above the level of the projector. The projected beam is therefore cast

slightly upwards, thus ensuring that the screen is not hidden from the front seats by the projector and epidiascope.

To accomplish this the microscope is raised up on a wooden bridge which spans the usual prismatic optical bench and is of any convenient height. In the present apparatus the top surface of the bridge is inclined so that the eyepiece end of the microscope is tilted away from the screen; the end of the bridge nearest the screen being 11·5 inches high, the lower end 9 inches high, and the depth 7 inches. The cross-measurement is also 7 inches. The microscope is secured to the bridge by means of a screw passing through the top of the bridge into a threaded hole in the foot.

The light from the bullseye is directed on to the plane mirror, D, and thence up the tube. The condenser used is a Watson Universal, E, most

Inches
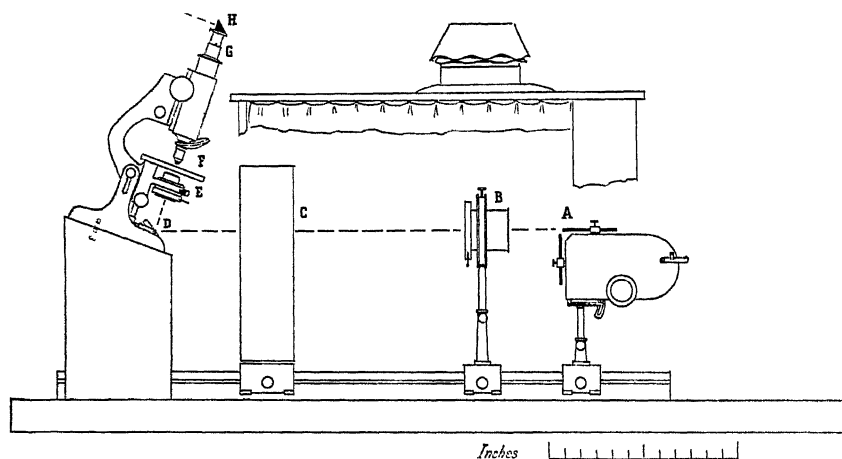
FIG. 1.—A, 5-amp. arc. B, Conrady bullseye. C, Water trough. D, Microscope mirror. E, Universal condenser (top lens removed). F, Holos 12 mm. G, Periplanat eyepiece × 5, with pointer. H, Right-angle projection prism.
N.B.—The roof of the lamp-house is shown 2 in. above its proper level.

frequently without its top lens. The objective is a 12-mm. Holos N.A. 0·65, F, and the eyepiece a Leitz Periplanat × 5 fitted with a pointer, G. Above the eyepiece is a silvered right-angled prism, H, the housing of which is provided with a tilting screw. This is not essential, but is a decided convenience for centring the image on the screen.

The screen distance is approximately 15 feet and the × 5 periplanat at this range throws a circle of about 6 feet diameter.

The screen used is a plain white-painted plywood one 7 feet square. A folding aluminium painted screen is also sometimes used and is definitely much superior in its reflecting power. It has the great disadvantage, however, of being too directional for demonstrations to a large class. With a class of 100 the aluminium screen can be used in our theatre since all the audience can be accommodated in a relatively narrow angle from the screen.

With the full class of 200; however, a large number have to be seated out-side the angle of reflection from the aluminium screen so that an opaque white reflecting surface is preferred, despite the very appreciable loss of light. It may be worth mentioning that if the aluminium screen is pivoted on a vertical axis it can be rotated so that the reflected beam can be directed towards the sides of the auditorium. The slight obliquity of the incident beam in this case is not associated with any appreciable falling off in the quality of projection, but the proceeding cannot be said to be very convenient.

The remaining details call for little comment. The arc, bullseye, and water trough are mounted on the optical bench and are enclosed in a curtained lamp-house. The roof is of wood lined with asbestos and provided with a lantern type chimney. The whole apparatus is mounted on a wooden base long enough to accommodate the arc resistance at the back, and the base is supported on a solid bench alongside the epidiascope. The micro-scope stand used should be a thoroughly steady one and be provided with a centring substage and·a really good mechanical stage. In setting up the apparatus, having centred the substage condenser in the ordinary manner, the positive crater of the arc is arranged vertically above the centre line of the optical bench and level with the centre of the mirror. The bullseye is removed and the image of the crater centred to the field of view. The bullseye is replaced and its iris diaphragm also centred to the field by means of the centring screws provided. Slight readjustments of the arc and bulls-eye may be necessary and no pains should be spared to ensure that accurate centration is achieved since slight errors in this respect cause a considerable falling off of light. The position of the arc and bullseye should be varied until the image of the positive crater when focussed on the object is only just large enough to fill the field. If it is too small it acts as a distraction, while if it is too large there is an unnecessary loss of illumination.

The choice of objectives and ocular will, of course, be governed by circumstances, but those mentioned can scarcely be improved on among present manufactures. The Holos 12 mm. has the largest ratio of aperture to power of any objective known to the writer, and hence will yield the brightest image. It so happens that the high-apertured medium-power apochromats are nearly all of 8-mm. focal length, so that with the same eyepiece and projection distance the image has only about one-half the brightness. Similarly the use of a × 6 eyepiece instead of a × 5 involves a loss of one-third of the light (assuming that the eyepieces are correctly rated).

The ½-inch gives an image of a very convenient magnification for histo-logical purposes. Under the conditions stated observers seated in the front rows can just distinguish between a polymorphonuclear and a lymphocyte in a well-stained section. For a more general view a Holos inch is used and the substage condenser adjusted so that the bullseye itself is focussed, the resulting definition, while not perfect, being adequate for general

topography.   Occasionally an oil-immersion 3 mm. N.A. 0·95 is used and the top lens of the condenser replaced.   It so happens that no readjustment of arc and bullseye are needed.   The image from the 3 mm. is definitely dull and the aluminium screen is needed, and on the whole the projection is not really satisfactory.

The apparatus has been in use in the class of Morbid Histology for two years and has proved of great value in demonstrating not only the general anatomy of tissues but also all but the most delicate of the pathological changes.   For finer cytology, such as the adequate demonstration of bone-marrow sections, it would seem necessary to employ an oil-immersion 3 mm. of N.A. 1·4 with a corresponding condenser—a very expensive and delicate equipment for class demonstrations.

XVIII.—THE OTOLITHS OF EIGHT SMALL YELLOW EELS FROM THE ETANG DE THAU.

By A. GANDOLFI HORNYOLD, D.Sc., F.R.M.S., F.Z.S.

TWO PLATES.

LAST April I worked on the small yellow eel of the Etang de Thau, and I studied chiefly the sex and the formation of the zones of growth of the scales. I do not say that the rings or zones represent years, as I am not convinced of their yearly formation in the eel.

I worked at the Zoological Station of Sète (formerly Cette), then under the direction of Prof. Bataillon. I thank him most sincerely for his kind hospitality and for all that he has done to help me in my work. I noticed that many of the otoliths had more or less curious forms, and I selected those of eight yellow eels of various sizes.

Mr. Fernand Angel of the Musée national d'Historie Naturelle of Paris made the drawings for this paper, and I thank him for all the pains he took to render the otoliths as perfectly as possible.

I begin by giving the sex, the length, and the weight of the eight eels, as also the mean dimensions of the otoliths and the magnification.

Sex.	Length, cm.	Weight, gr.	Mean dimensions of Otoliths, mm.				Magnifica-tion.
♀	53	242	Fig. 1 Left, Fig. 2 Right	3·3 × 2·4			× 18
♀	44	123	,, 3 ,, ,, 4 ,,	3·0 × 2·0			× 22
♀	42	99	,, 5 ,, ,, 6 ,,	2·7 × 2·0			× 22
♀	38	72	,, 7 ,, ,, 8 ,,	2·4 × 1·8			× 26
♀	36	68	,, 9 ,, ,, 10 ,,	2·5 × 1·8			× 24
♀	36	60	,, 11 ,, ,, 12 ,,	2·9 × 1·9			× 20
♂	35	64	,, 13 ,, ,, 14 ,,	2·0 × 1·5			× 30
♀	34	70	,, 15 ,, ,, 16 ,,	2·5 × 2·0			× 24

The left otolith of the 53-cm. eel (pl. I, fig. 1) is ovate, the dorsal rim is curved, the ventral nearly straight. Both are serrated, and especially so the dorsal rim. The posterior rim is rounded with a few small indentations and a slight notch where the sulcus ends. The antirostrum is formed by two small protuberances divided by a notch. An excisure is present, and the rostrum is large and pointed. The straight undivided sulcus opens out very widely, covering the front rim, and tapers down to a point at about five-sixths of the length. It continues in a curved narrow channel, gradually

becoming very shallow, and ends on the posterior rim in the notch. The sulcus is very shallow and slopes down very gradually on the ventral side towards the front rim.

The right otolith (pl. I, fig. 2) is also ovate. The dorsal rim is oblique and serrated. The ventral rim is slightly curved with various indentations, and the posterior rim is flattened with a notch in line with the end of the sulcus. There is neither antirostrum nor excisure, and the rostrum ends in a small sharp point. The straight undivided sulcus opens out very widely on the front rim and tapers down gradually, ending rounded at about five-sixths of the length. The sulcus slopes down on the ventral side more than in the left otolith, and is also narrower.

The left otolith of the 44-cm. eel (pl. I, fig. 3) is more elongated. The dorsal rim is curved, the ventral straight, and the posterior rim is rounded with two notches. The antirostrum is small and flattened. An excisure is present and the rostrum is large and obtuse. The straight undivided sulcus opens out widely on the front rim, tapers down, and ends rounded at three-quarters of the length. On the ventral side the sulcus is very shallow and slopes down very gradually, especially towards the front rim. The deepest part forms a narrow channel on the dorsal side.

The right otolith (pl. I, fig. 4) is less elongated, the dorsal and the posterior rims are rounded, and both are serrated. The ventral rim is straight and has no indentations. The antirostrum and excisure are barely indicated, and the rostrum is large, obtuse, and divided by two notches. The straight undivided sulcus opens out widely on the front rim and tapers down, ending rounded at about two-thirds of the length of the otolith. Towards the front rim the ventral side of the sulcus slopes down so very gradually that contour is indistinct. The deepest part of the sulcus forms a curved channel on the dorsal side.

The left otolith of the 42-cm. eel (pl. I, fig. 5) is quadrangular, both the dorsal and ventral rims are nearly straight, and the posterior rim is flattened and oblique. All the rims have some indentations. The antirostrum and excisure are just indicated, and the rostrum is very large and rounded. The straight undivided sulcus opens out very widely on the front rim and ends rounded after tapering down slightly at three-quarters of the length. The ventral side of the sulcus is very shallow, sloping down so gradually, especially towards the front rim, that contour is indistinct. On the dorsal side the sulcus is deep and the contour well marked.

The right otolith (pl. I, fig. 6) is more elongated, the dorsal rim is straight, the ventral rim slightly curved, and the posterior rim is flattened. The dorsal and posterior rims are serrated, and the posterior rim has a curious very deep notch. The antirostrum is large and is divided by a notch. An excisure is present. The rostrum is large and ends flattened and divided by a small notch. The straight, wide, undivided sulcus opens widely on to the front rim. It does not taper down, and ends rounded at about three-quarters of the length of the otolith. A narrow channel continues as far as
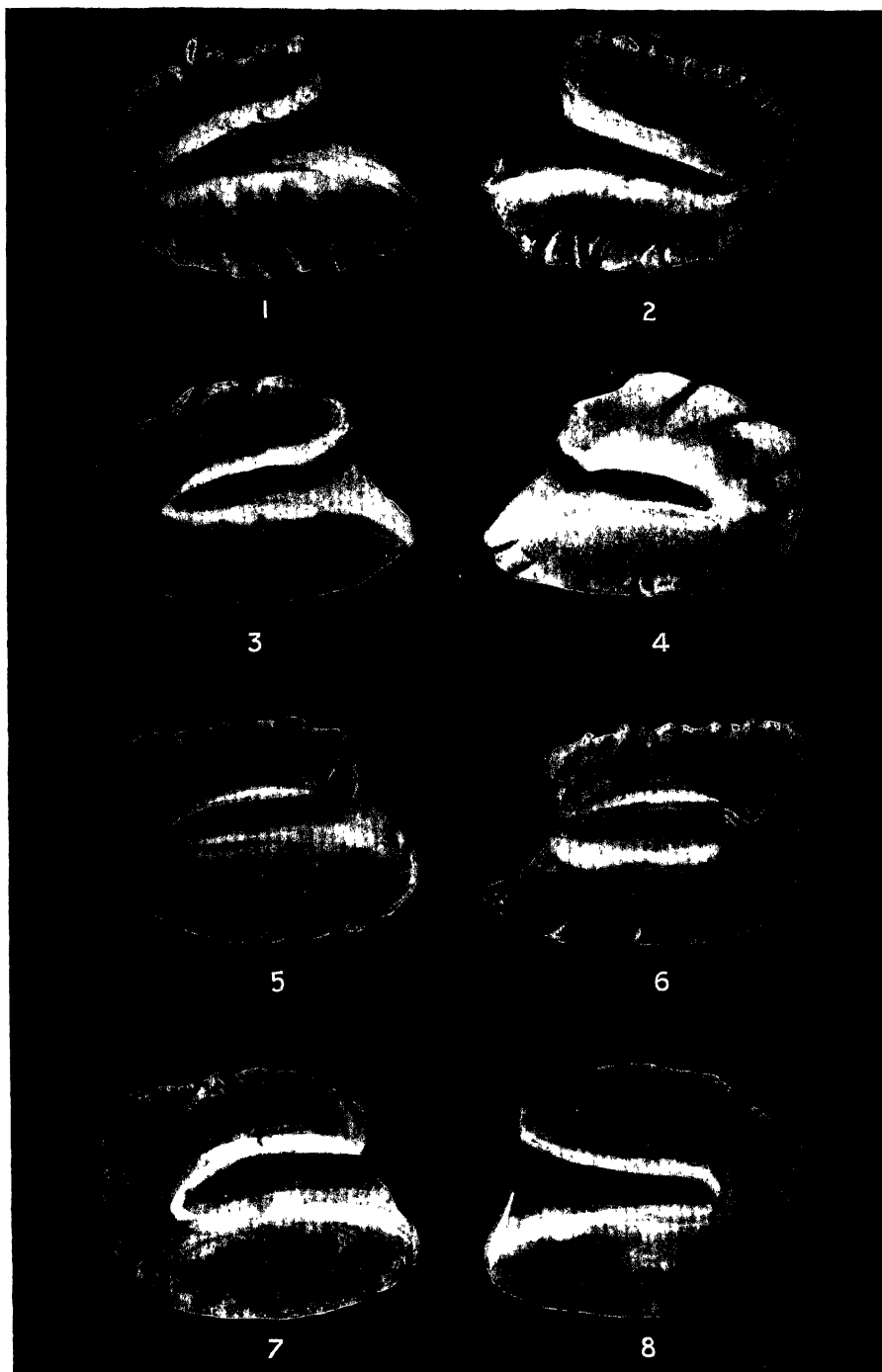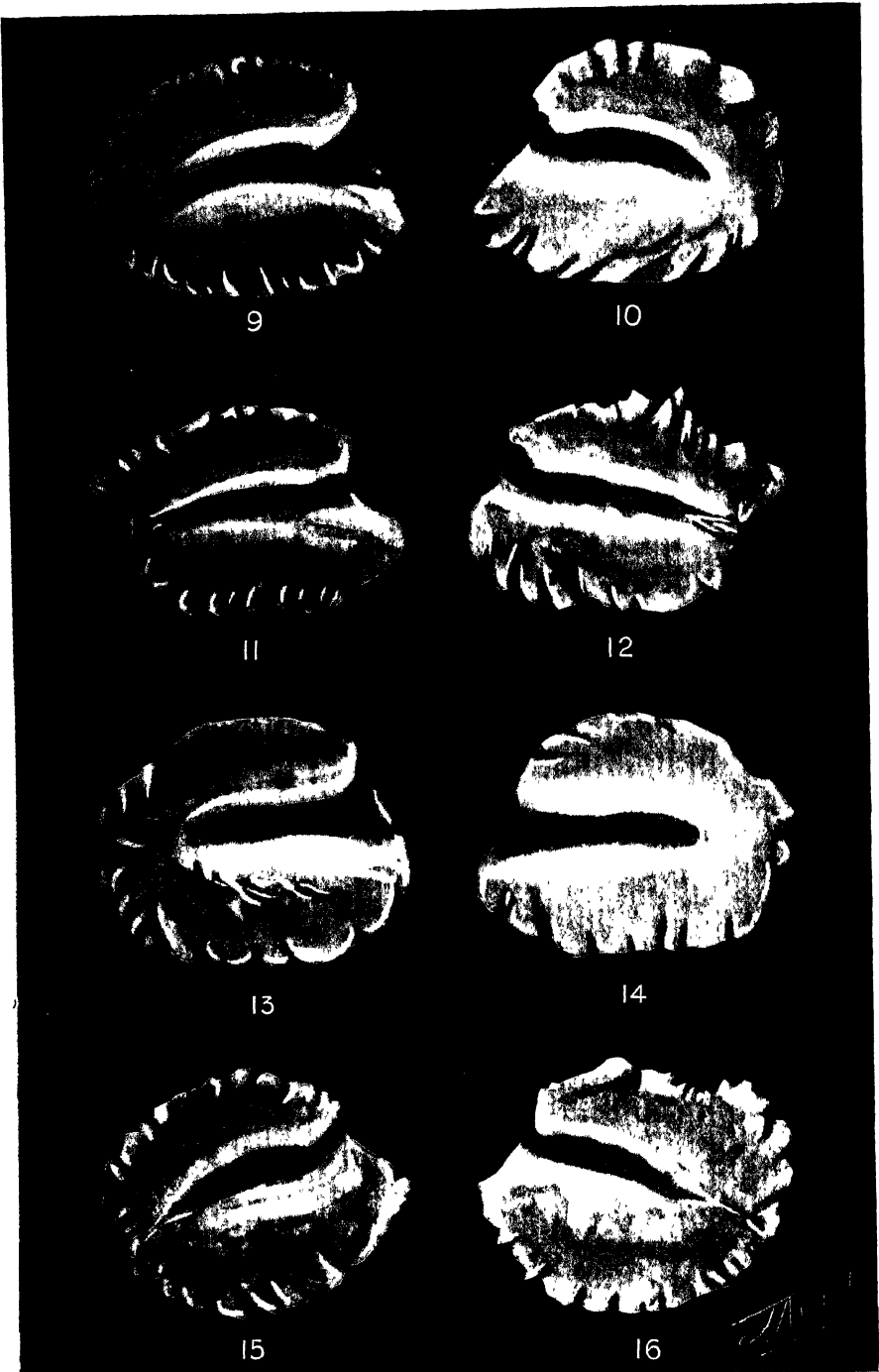
the posterior rim, opening out in the notch. The ventral side of the sulcus is very shallow with an indistinct contour, and the deepest part forms a narrow channel on the dorsal side.

The left otolith of the 38-cm. eel (pl. I, fig. 7) is elongated, both the dorsal and ventral rims are very slightly curved, and the posterior rim is rounded. There are a few slight indentations on the posterior rim, and both the dorsal and ventral rims are practically smooth. Antirostrum and rostrum are large and rounded. An excisure is present. The wide, un-divided, slightly curved sulcus opens out widely on the front rim. It hardly tapers down and ends rounded at about three-quarters of the length of the otolith. The sulcus is shallow and has an indistinct contour towards the front rim on the ventral side.

The right otolith (pl. I, fig. 8) is also elongated, the dorsal rim is more curved than in the left otolith, the ventral rim is nearly straight. Both are quite smooth. The posterior rim is flattened, oblique, and slightly serrated. Both antirostrum and rostrum are rounded, but are smaller than in the left otolith. An excisure is present. The slight undivided sulcus opens out on the front rim widely and tapers down gradually, ending rounded at about two-thirds of the length of the otolith. Though the ventral side of the sulcus is shallow, contour is distinct.

The left otolith of the 36-cm. and 68-gr. eel (pl. II, fig. 9) is elongated. The dorsal rim is curved, the ventral nearly straight, and the posterior rim is rounded. The antirostrum is large and rounded, the rostrum is large and forms a blunt point. The excisure is very large. All the rims are slightly serrated. The wide, straight, undivided sulcus opens out on the front rim, tapers down slightly, and ends rounded at about three-quarters of the length. The ventral side of the sulcus is shallow, sloping down very gradually, especially towards the front rim, so that the contour is not very distinct. The deeper part of the sulcus forms a wide channel on the dorsal side.

The right otolith (pl. II, fig. 10) is of a more ovate form. The dorsal rim is curved, the ventral rim is straight, and the posterior rim rounded. All have some indentations. The antirostrum is large and forms a blunt point, and the rostrum is large, flattened, and slightly oblique. The excisure is very large. The wide, undivided, straight sulcus opens out widely on the front rim, and ends in a point at about three-quarters of the length. The deeper part of the sulcus forms a curved channel on the dorsal side, and the ventral side is very shallow towards the front rim, and contour is not very distinct.

The left otolith of the 36-cm. and 60-gr. eel (pl. II, fig. 11) is elongated, the dorsal rim is curved and slightly serrated, the ventral rim is straight and deeply serrated. The posterior rim is flattened with a curious protuberance near the dorsal rim. The antirostrum is large and obtuse, the rostrum large and rounded. An excisure is present. The straight, undivided sulcus opens out fairly widely on to the front rim and tapers down gradually. At

about two-thirds of the length of the otolith the sulcus becomes very shallow, and ends indistinctly on the posterior rim.

The right otolith (pl. II, fig. 12) is elongated, the dorsal rim is curved and very deeply serrated, the ventral rim is straight with indentations, and the posterior rim ends in a large protuberance. Below it there is a slight protuberance between two very slight notches. The antirostrum is small, the rostrum large and rounded. An excisure is present. The fairly wide, straight, undivided sulcus opens out widely on to the front rim. It tapers down gradually and ends on the posterior rim below the protuberance. The ventral side of the sulcus is very shallow and is not very distinct near the front rim. The deep part forms a wide channel on the dorsal side. At the end near the posterior rim the sulcus is divided into two narrow channels.

The left otolith of the 35-cm. eel (pl. II, fig. 13) is elongated. The dorsal rim is curved and the ventral rim straight. The posterior rim is rounded. The antirostrum is very small, the rostrum large, and both are rounded. An excisure is present. The very wide, straight, undivided sulcus opens out on the front rim, covering the greater part of it. The sulcus tapers down very slightly and ends rounded at about two-thirds of the length. The ventral side slopes down very gradually, but the contour is fairly distinct. The deeper part forms a wide channel on the dorsal side.

The right otolith (pl. II, fig. 14) is elongated. The dorsal rim is curved and the ventral straight. The posterior rim ends in two protuberances. The one near the dorsal rim is pointed, and the one below rounded. There is neither antirostrum nor excisure, and the rostrum is large and obtuse. The sulcus is less wide than in the left otolith, is straight and undivided, ending rounded at about two-thirds of the length. On the ventral side the sulcus is less shallow and slopes down less gradually than in the left otolith, and the contour is even more distinct.

The left otolith of the 34-cm. eel (pl. II, fig. 15) is ovate, but the dorsal and ventral rims are curved. The posterior rim has two protuberances divided by a fairly deep notch. The antirostrum forms a small point. An excisure is present, and the rostrum is large and ends in an irregular point. The undivided, oblique sulcus opens out widely on the front rim and ends indistinctly near the notch on the posterior rim, but does not reach it. The ventral side of the sulcus is very shallow, and the contour is indistinct near the front rim.

The right otolith (pl. II, fig. 16) is more elongated, both the dorsal and ventral rims are curved and serrated, the dorsal rim especially so. The posterior rim is rounded with indentations. The antirostrum and rostrum form points, the first being small and the latter large. An excisure is present. The wide, oblique sulcus opens out widely on the front rim and tapers down, ending not very distinctly on the posterior rim. The contour of the sulcus is fairly distinct on the ventral side.

In comparing the figures of the sixteen otoliths belonging to eight small yellow eels from 34 to 53 cm. long, we can observe a considerable differentia-

tion in their form, or in that of the sulcus, or in both. The normal type is rare, and in none of the otoliths is the sulcus divided into an ostium and cauda.

No two otoliths of the same eel are identical, but all have greater or lesser differences in the form, or in that of the sulcus, or in both. I only give the following examples.

Both otoliths of an eel can have more or less similar irregularities, and such is the case in the 36-cm. and 60-gr. eel (pl. II, figs. 11 and 12). Here in both the otoliths the posterior rim ends in a curious protuberance which, however, is very much larger in the right otolith. The right otolith has much deeper indentations and the form of the sulcus also differs. The otoliths of the 53-cm. eel (pl. I, figs. 1 and 2) have a similar form, but the sulcus differs and the rostrum is just indicated in the left otolith, but in the right one there is no trace of it. The form of the rostrum differs also.

Some of the otoliths have strange forms, as in the case of those of the 34-cm. eel. Here the form of the sulcus and that of the rostrum differ (pl. II, figs. 15 and 16). The otoliths of the 38-cm. eel (pl. I, figs. 7 and 8) have a similar form, but antirostrum, rostrum, and sulcus differ. The right otolith of the 42-cm. eel (pl. I, fig. 6) has a curious notch on the posterior rim and a curious claw-shaped rostrum.

The otoliths of the 38-cm. and of the 36-cm. and 68-gr. eels are nearest to the normal clupeoid type of the eel otolith (pl. I, figs. 7 and 8, and pl. II, figs. 9 and 10). Rostrum, antirostrum, and excisure are present, the sulcus is wide and open, undivided, or with a slight angle of lower line.

In some cases the excisure is very large and the rostrum and antirostrum form a right angle (figs. 6, 9, 10 and 11).

This paper shows once more the great variation of the otoliths of the eel, and the more one examines eels from various localities the more curious are the forms one finds.

535.824.2.   XIX.—A NEW OBJECTIVE FOR METALLURGY.*

By H. WRIGHTON, B.Met.

ONE PLATE.

AT a meeting of this Society in the Autumn of last year, mention was made of a computation worked out by Mr. Bracey, of the British Scientific Instruments Research Association, for an immersion objective of N.A. 1·60. The objective is a monochromat, and has a working distance too close to allow of the use of a cover slip, both of which qualities rather limit its usefulness for biological or similar work. They are not, however, of consequence in metallography ; metal specimens are almost entirely monochromatic in character, and allow of the use of a narrow wave-band of light suited to the corrections of a monochromatic objective.

The writer has for a number of years urged the desirability of a bold curvature on the back lens of objectives for metallurgy, in order to reduce glare, and this requirement was found to be adequately met in the computation.

The original computation was for an objective of 3 mm. focal length, and it was thought that some improvement might be effected in this respect. In a paper read before this Society in 1927 the writer showed micrographs, taken with an apochromat of N.A. 1·30, in which resolution of the order of 140,000 lines per inch was obtained. Considerable magnification is necessary if such a structure is to be clearly shown in a printed reproduction. A screen magnification of 1000 diameters gives an image showing 140 lines per inch, and detail of this order suffers badly when reproduced by the usual 175-line half-tone process. A magnification of 2000 diameters for reproduction purposes, to show the finer detail which the monochromat might yield, made it desirable that a somewhat higher primary magnification should be obtained in the objective itself if possible.

Accordingly a new computation was made for a shorter focal length, and at the same time alterations in design were made with the object of still further reducing glare, by lessening reflection at internal lens surfaces. From this computation the objective has been made by Messrs. Beck. The new objective has a focal length of 2·25 mm. and is computed for a tube length of 180 mm. and for light of λ4359, which is the blue line of the mercury arc. The N.A. is 1·60 and the immersion fluid is monobromide of naphthalene.

Tests were first made with the mercury vapour lamp, but when the blue light had been effectively isolated and the nearby violet light extinguished,

* A communication from the Research Department, Woolwich.

A. PHOTOMICROGRAPH OI LAMELLAR
   PEARLITE IN STEEL. MAGNIFICATION × 2500

B. PORTION OF A ENLARGED, MAGNIFICATION × 10000

it was found that the light-intensity was much too low for metallographic work, the exposures required being far too long to be practicable.

Light from the 100 c.p. Pointolite lamp, filtered through a Wratten 50L screen, was found to be of much higher intensity, and spectrometric tests showed the wave-band passed to be quite narrow, and of very closely the correct mean wave-length.

The images given by the objective are of excellent definition and bear high eyepiecing remarkably well ; glare is almost entirely absent and is less than in any other objective the writer has used.

The micrograph shown was taken at a magnification of 2500 diameters, using the full aperture of the objective, the back lens being evenly and completely filled with light ; the exposure, on an Ilford Press plate, was 45 seconds. The specimen is of fine lamellar pearlite in steel ; lamellæ of 160,000 lines per inch are separated with ease and clarity, and resolution of 200,000 lines per inch is attained at one point in the photograph where two lines of a group averaging 150,000 converge more closely together.

This is a very satisfactory performance, and the objective should be of definite value to metallographers. In one or two respects it is more suitable for metallurgical work than an oil immersion lens. The specimens may, by rinsing with a few drops of acetone from a dropping bottle, be cleared of immersion fluid with ease, and examined again at lower powers without need of further cleaning or repolishing. Cedar wood oil is much more difficult to remove completely, particularly if it has been left on the specimen some little time. The short working distance of the objective is an advantage in that no difficulty is experienced in maintaining the immersion film and, further, there is less risk of disturbance of focus through tension in the film, as may easily occur when rather thick cedar wood oil is in use.

The objective, when applied to the examination of metals and alloys, has given some suggestion of form to minute particles which previously have been imaged in quite indefinite shape. The clarity of imaging of these smallest details of structure seems, however, to vary a little from one preparation to another, even of the same specimen. This suggests that some refinement in the technique of preparation of the specimens is needed before the fullest use can be made of resolving power of this high order.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.*)*

HISTOLOGICAL TECHNIQUE AND STAINING.

Studies in Micrurgical Technique.—J. A. REYNIERS (*J. Bact.*, 1933, **26**, 251–87, 8 text-figs.). In this paper, which should be read in the original by those interested, new apparatus is described for the isolation of single bacteria. The first section considers (i) methods used by others to isolate single bacterial cells, (ii) the necessary principles to mechanize completely such a technique, (iii) a review of the methods used by the writer to accomplish this mechanization. To this end a new micro-manipulator is described in detail. In this the moist chamber is never exposed to the air and is replaceable. Uniform pipettes are made by a mechanical apparatus which allows pipettes of any desired size to be manufactured in large numbers. G. M. F.

Salicylic Acid as a Fixative.—I. COHEN ("The Use of Salicylic Acid as a Fixative," *Stain Technol.*, 1933, **8**, 153–6). The following salicylic acid-containing fixatives are useful for cytological studies especially in plants. HFC is made up in two solutions. Solution A : 100 c.c. saturated aqueous solution of salicylic acid, a slight excess of copper hydroxide, 20 c.c. formaldehyde, 30 c.c. normal ortho-phosphoric acid, 200 c.c. water, 1 gm. saponin: pH 1·8–1·9. Fix in solution A 15–30 minutes in a partial vacuum of 35 cm. Then add solution B—a 1 p.c. aqueous solution of chromic acid—in equal amount. Continue fixation for from 18 to 24 hours. HFP is also made up in two solutions which are used in equal parts. Solution A : 100 c.c. of a saturated aqueous solution of salicylic acid, a slight excess of copper hydroxide, 10 c.c. normal ortho-phosphoric acid, 0·5 gm. saponin. Solution B : 187·5 c.c. of 1 p.c. aqueous solution of chromic acid, 50 c.c. of 2 p.c. osmic acid. Fixation technique as in HFC. Dehydrate and infiltrate with paraffin after Zirkle's method. Stain with crystal violet, iodine. G. M. F.

Paraffin Embedding.—R. T. HANCE ("A New Paraffin Embedding Mixture," *Science*, 1933, **77**, 353). A stock solution of crude rubber in paraffin is first made ; either smoked or unsmoked crude rubber in sheets is suitable. The sheets are chopped up with scissors and dropped into melted paraffin. The paraffin should be smoking hot and the mixture should be stirred occasionally. Three to four hours are required to melt the rubber completely. About 20 gm. of rubber can be dissolved in 100 gm. of paraffin. The embedding mixture consists of : paraffin, 100 gm. ; rubber-paraffin mixture, 4–5 gm ; beeswax, 1 gm. The mixture is pale yellow in colour, does not readily crystallize, and is of a waxy consistency that sections unusually well. G. M. F.

Standardization of Biological Stains.—A. R. PETERSON, H. J. CONN, and C. G. MELIN ("Methods for the Standardization of Biological Stains. Part I. General Considerations," *Stain Technol.*, 1933, **8**, 87–94). This is the introduction to a series of papers giving the assay methods employed in the testing of dyes submitted to the American Commission on the Standardization of Biological Stains in order to determine whether any particular batch of dye shall be issued as a certified stain. The present paper takes up general considerations, discussing the relative merits of various analytical methods, both qualitative and quantitative. The advantages of determining light "absorption ratios" for qualitative purposes and of titanous chloride reduction for quantitative purposes are pointed out. It is further indicated that in spite of all the refinements that have yet been made in chemical and optical methods of analysis, great weight must be placed on biological testing in determining the quality of any given sample.   G. M. F.

Standardization of Biological Stains.—A. R. PETERSON, H. J. CONN, and C. G. MELIN ("Methods for the Standardization of Biological Stains. Part II. The Fluorane Derivatives," *J. Stain Technol.*, 1933, **8**, 95–100). Methods for standardization of the following dyes are given—fluorescein, eosin yellowish, ethyl eosin, eosin bluish, erythrosin, phloxine B and rose bengal. For each of these dyes particulars are given of qualitative tests, quantitative analysis and biological tests. (Part III. Certain Nitro and Azo Dyes, *Stain Technol.*, 1933, **8**, 121-130) Similar methods are described for the standardization of Martius yellow, orange G, Janus green B, methyl orange, orange II, Sudan III, Sudan IV, Bismarck brown Y, Birmarck brown R, Congo red and Erie garnet B.

G. M. F.

Trichrome Staining Methods.—N. C. FOOT ("The Masson Trichrome Staining Methods in Routine Laboratory Use," *Stain Technol.*, 1933, **8**, 101–10). A résumé of Masson's trichrome staining methods is given, with detailed directions for carrying out all his procedures. The best fixative is a Bouin's solution composed of commercial formalin (40 p.c. formaldehyde), 10 parts; 2 p.c. aqueous solution of trichloracetic acid, 2 parts; and a saturated aqueous solution of picric acid, 30 parts: other fixatives may, however, be used. The stains described include his hæmatoxylin-phloxine-saffron, iron hæmatoxylin-ponceau-aniline blue, his variations of this stain of which the light green stain is excellent, his metanil yellow, and his modification of the familiar Van Gieson technique. The "light green" stain is probably the most satisfactory. Sections are first mordanted in a 5 p.c. aqueous solution of iron alum at 45°–50° C. for 5 minutes; washed in tap water and stained for 5 minutes in Regaud's hæmatoxylin (1 gm. of hæmatoxylin dissolved in 80 c.c. of hot distilled water; the solution is cooled and 10 c.c. of 95 p.c. alcohol and 10 c.c. of glycerol are added). Sections are differentiated in a saturated alcoholic solution of picric acid (95 p.c. alcohol), 2 parts, to 1 part of 95 p.c. alcohol till the nuclei alone retain the stain and the collagen fibres are no longer grey. Sections are then washed for 15 minutes in running water. As cytoplasmic stains either ponceau dexylidine or ponceau-acid fuchsin, are employed. A 1 p.c. solution of ponceau dexylidine is made up in distilled water containing 1 p.c. of glacial acetic acid. Sections are stained for 5 minutes, rinsed in distilled water, and taken into the connective tissue stain. Ponceau-acid fuchsin, for which the same length of staining is employed, is made by mixing 2 parts of the above ponceau solution with 1 part of acid-fuchsin solution in 1 p.c. of acetic acid. This gives a wider range of reds. Instead of staining for 5 minutes only with the strong solution, it may be diluted with 10 parts of distilled water containing 1 p.c. of

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acetic acid and staining continued for an hour or more. Before staining with light green, sections are mordanted for 5 minutes in 1 p.c. aqueous phosphomolybdic acid, rinsed in distilled water, and stained for 5 minutes in a light green solution made by boiling 2 gm. of light green in 100 c.c. of distilled water, adding 2 c.c. of glacial acetic acid and cooling. G. M. F.

Capsular Staining of Tetanus Bacilli during Sporulation.—J. W. CHURCHMAN (" The Tinctorial behaviour of the Capsule in *Clostridium tetani* during Sporulation," *Stain Technol.*, 1933, 8, 111–6, 1 pl., 3 text-figs.). Bacterial smears are stained with Wright's stain which is allowed to evaporate almost to dryness without diluting ; it is then washed off rapidly with a buffer solution (*p*H 6·5) and is quickly dried by fanning. Using this technique various new structures are observed in the sporulation of *Clostridium tetani* and *C. Welchii*. G. M. F.

Starch and Fat in Protozoa.—W. L. DOYLE (" Method for Simultaneous Demonstration of Starch and Fat in Protozoa," *Stain Technol.*, 1933, 8, 117). Two stock solutions are prepared, one containing a 0·3 p.c. solution of iodine in 60 p.c. alcohol, the other a saturated solution of Sudan III or Scharlach R in a mixture containing 60 p.c. alcohol and 10 p.c. acetone. Equal parts of each solution are mixed in a small bottle to contain 24 hours' supply. The stock solutions keep indefinitely, whereas the mixture decomposes in from 36 to 72 hours. The amount of acetone may be varied as the solubility of the fat permits. The higher the percentage of acetone the more intense the fat stain. The mixture may be used as a killing fluid or the organisms may be previously killed with neutral saline formol. G. M. F.

A Note on Iron Hæmatoxylin.—R. T. HANCE (*Stain Technol.*, 1933, 8, 117). An alcoholic stock solution of hæmatoxylin has a limited period of usefulness but an 0·5 p.c. solution will not deteriorate in less than three months. If a trace of sodium bicarbonate is added to a new 0·5 p.c. solution it may be used at once and reaches maximum efficiency in a few hours. G. M. F.

Phloxine and Orange G as Counterstains.—L. A. MARGOLENA (" Phloxine with Orange G as a Differential Counterstain," *Stain Technol.*, 1933, 8, 157). Sections fixed in Zenker or Ruffini's fluid are stained with Heidenhain's or Harris hæmatoxylin and differentiated. They are transferred from distilled water to an 0·5 p.c. solution of phloxine in 20 p.c. alcohol for one or more minutes, rinsed in 70 p.c. alcohol, after which an 0·5 p.c. solution of orange G in 95 p.c. alcohol is dropped on the sections for 20–30 seconds or more. Dehydration in absolute alcohol, clearing in xylol and mounting in balsam follow. G. M. F.

Schaudinn's Fixative for Protozoa.—D. H. WENRICH and Q. M. GEIMAN (" A Modification of Schaudinn's Fixative for Protozoa," *Stain Technol.*, 1933, 8, 158). Various protozoa were fixed in Schaudinn's fluid with no acetic acid or with 2, 5, 10, 15, and 20 p.c. glacial acetic acid. The best fixation varies with the type of protozoan being fixed and the type of structure to be demonstrated. Half-strength Schaudinn's fluid with 2 p.c. glacial acetic acid gives the best general fixation for small flagellates. G. M. F.

The Physical Chemistry of Histological Staining with Carmine.—K. SEKI (" Zur physikalischen Chemie der histologischen Färbung. III. Über die Karminfärbung," *Folia anatom. japonica*, 1933, 11, 1–13). The isoelectric point of carmine lies between *p*H 4·0–4·5 ; it is then almost insoluble. Carmine is

positively charged by the presence of alum or aluminium sulphite and goes into solution. It then acts as a basic dye, staining deeply the negatively charged cell nucleus, the hyaline cartilage, and mucus. When negatively charged the tissues are only diffusely stained since they are in general negatively charged. It is only after subsequent differentiation with acid solution that the nuclei and other structures now stain intensely with the positively charged dye.   G. M. F.

The Physical Chemistry of Histological Staining with Hematein.—K. SEKI ("Zur physikalischen Chemie der histologischen Färbung. IV. Über die Hamateinfärbung," *Folia anatom. japonica*, 1933, **11**, 15–36). Hæmatoxylin is only weakly negative, but its oxidation products, hæmatein and oxyhæmatein, have a strongly negative charge. The isoelectric point of hæmatein is about pH 6.5. On ripening, the negative charge of hæmatoxylin is increased and it can the more readily combine with alum or iron-alum to form a lake. The lake thus produced has a positive charge and stains like a basic aniline dye. Hematein charged with positive hydrogen ions also stains like a basic dye without being converted into a violet lake.   G. M. F.

Fixatives for the Demonstration of Glycogen in the Tissues.—P. BURGH-GREAVE ("Etude sur la valeur comparative de différents fixateurs en vue de la recherche du glycogène dans les tissus," *Bull. d'Histol. appl.*, 1933, **10**, 73–86). Bark's absolute alcohol-formalin or Vastarini-Cresi's fixative (95 p.c. alcohol, 100 parts ; formalin, 10 parts ; acetic acid, 5 parts) are probably the best fixatives. Absolute alcohol is so slow in penetration that it does not prevent glycolysis in the inner portions of the material, while commercial formalin, saturated with dextrose, hardens the tissue. Paraffin embedding is quite as satisfactory as celloidin, but if the material is very hard a 5 p.c. celloidin solution may be brushed over the block between each section. The application of water instead of alcohol for the sections has no influence on glycogen.   G. M. F.

A Rapid Method of Staining Sections with Giemsa.—W. L. McNAMARA ("Giemsa Stain for Tissue, Rapid Method," *J. Lab. & Clin. Med.*, 1933, **18**, 752). Fix in Zenker's fluid for 48 hours or more. Wash for 24 hours and bring up to paraffin. Section 4μ–6μ thick ; bring down to water ; treat with Lugol's solution for 30 minutes, followed by one change of 95 p.c. alcohol and one of tap water. Treat for 10 minutes in a 0·5 p.c. solution of sodium hyposulphite and wash well in tap water. Stain for 15 minutes in the following : Giemsa stain, 10 c.c. ; acetone, 10 c.c. ; methyl alcohol, 10 c.c. ; 0·5 p.c. sodium, carbonate 2 drops ; distilled water, 100 c.c. Wash rapidly in water and differentiate in Wolbach's mixture (Colophonium, 15 gm. ; acetone, 100 c.c.). Treat the sections separately changing the solution once ; differentiation takes from 15 to 45 seconds. Pass through a mixture of 7 parts acetone and 3 parts xylol. Follow with xylol and mount in cedarwood oil.   G. M. F.

New Stains.—M. CLARA ("Über einige neue einfache gleichzeitige (simultane) Färbungen," *Ztschr. Wiss. Mikr.*, 1932, **49**, 348–52). Hollborn & Son (Leipzig) have produced certain new stains. Hæmatoxylin H does not require ripening and no mordant is necessary. The dye is prepared as follows : 1 gm. is dissolved in 100 c.c. of hot distilled water, cooled, and filtered. A sharp chromatin stain is obtained while the cytoplasm remains colourless or shows a grey or light violet tone. Excellent results are obtained by combining hæmatoxylin H and van Gieson's elastin H (Hollborn's picric-acid-fuchsin-orcein mixture). The hæma-toxylin is allowed to act for from 10 to 20 minutes, the sections are then rinsed

and placed in 0·5 p.c. van Gieson's elastin H in 70 p.c. alcohol for 1½ hours, dehydrated, and mounted. Results: nuclei black, elastic fibres brown, connective tissue red, cytoplasm of other tissue yellow. "Nucplascoll" is a differential stain, the main component of which is hæmatoxylin H. It is used in a 2 p.c. aqueous solution (dissolved in hot distilled water, cooled, and filtered). The sections are transferred to this from distilled water for 30–40 minutes, rinsed, dehydrated, and mounted. Results: nuclei violet-black, greenish or brownish-black; nucleoli reddish; nuclear membrane clearly outlined; cytoplasm light greyish-green or yellowish-brown; red blood corpuscles yellow-red; and collagen fibres green. Neither nucplascoll nor hæmatoxylin H render tissues brittle. "Kernechtrot Kombination H" is also a differential stain, used in the same manner as hæmatoxylin H except that the sections must be watched to avoid overstaining. Results after formalin, sublimate, or alcohol fixation are as follows: nuclei bright red, collagen fibres bright blue, red blood corpuscles yellow, cytoplasm pale blue to reddish. Kernechtrot can also be used as a nuclear stain alone, in which case a 0·1 p.c. solution in 5 p.c. ammonia alum is recommended for from 1 to 5 minutes. G. M. F.

Carrying through Protozoa in Bulk.—E. W. HEIL ("A Simple Method for Carrying Protozoa in Bulk Through Reagents," *Stain Technol.*, 1933, 8, 149–152, 8 text-figs.). Hoggan's histological rings, commonly used in the preparation of mesenteric tissue material, are employed. They consist of a short tube of hard rubber over which is fitted a concentric ring of the same material having a slightly larger diameter. Over the base of the tube is stretched a square of fine silk bolting which is kept taut by clamping the ring over it. G. M. F.

A Modified Flagellar Stain.—W. N. STEIL ("A Method for Staining Certain Bacteria and Antherozoids," *Stain Technol.*, 1933, 8, 139–42). In this modification of Loeffler's method for staining bacterial flagella, a film of the bacteria or antherozoids in water is allowed to dry on a slide or fixed by exposure for about 2 minutes to the fumes of a 2 p.c. osmic acid solution. The slide is then immersed for from 10 minutes to several hours in a saturated solution of tannic acid, washed and stained. Safranin and fast green gave excellent results. G. M. F.

Block Staining of Nervous Tissue with Silver.—H. A. DAVENPORT ("Block Staining of Nervous Tissue with Silver. III. Pericellular End-bulbs or Boutons," *Stain Technol.*, 1933, 8, 143–8). Fixation in 20–40 p.c. pyridine or in 10 p.c. chloral hydrate followed by 10–40 p.c. pyridine gave the most consistent staining of pericellular structures in the spinal cord of the cat. Chloral hydrate perfusion and soaking followed by ammoniated alcohol (Hoff's application of Cajal's method) was uniformly successful only when pyrogallol instead of hydroquinone was used as a reducing agent. Perfusion of the animal with chloral hydrate gave a rather questionable degree of improvement over fixation by simple soaking. The difficulty in selecting a routine procedure as the "best" became apparent when no single experimental variation was outstandingly superior in all animals. G. M. F.

Gentian Violet for Staining Spirochæta pallida.—M. ZINGALE ("Colorazione c. della *Spirochæta pallida* al violetto di genziana diluito e alcalinizzato," *Policlinico*, 1932, 31, 1435–6). The following solutions are prepared: (1) A saturated alcoholic solution of gentian violet, 10 c.c.; filtered aniline water, 100 c.c.; (2) potassium carbonate, 100 gm. dissolved in 200 c.c. of water. Ten or 12 c.c. of solution (2) are placed in a watch glass and 10–12 drops of the gentian

violet are added. After fixation of the smear in the flame, the slide is placed face downwards in the staining solution and this is warmed till steam rises. Staining is continued for 3 minutes; the slide is then washed and dried. G. M. F.

The Chemical Reaction Produced by the Colon Bacillus on Endo's Medium.—L. A. MARGOLENA and P. A. HANSEN ("The Nature of the Reaction of the Colon Organism on Endo's Medium," *Stain Technol.*, 1933, **8**, 131–8). The main constituent of basic fuchsin is the chloride or acetate of rosanilin or pararosanilin which dissolve in water with the production of a fuchsia colour. When the dye is treated with sulphurous acid a colourless compound results, but when an aldehyde is added the colour is "restored." The regenerated dye is, however, slightly different to the original dye in composition. The typical reaction for *Bacterium coli* on Endo's medium is caused not by lactic acid but by the intermediate product acetaldehyde. G. M. F.

The Best Method of Staining for Tubercle bacilli.—C. J. KOERTH and R. J. B. HIBBARD ("The Comparative Efficiency of the Three Stains for Tubercle Bacilli," *J. Lab. & Clin. Med.*, 1933, **18**, 535–7). A comparison was made of the results of staining the sputa of 600 patients by three different methods: (*a*) Ziehl-Neelsen—steam with carbol fuchsin for 5 minutes, wash, acid alcohol 8 minutes, wash, 1 p.c. methylene-blue 30 seconds. (*b*) Schulte-Tigges—steam with carbol fuchsin for 1 minute, wash, decolorize with 10 p.c. sodium sulphite till the colour disappears, wash, counterstain with saturated picric acid, wash and dry. (*c*) Spengler—stain with carbol fuchsin, warm but not hot enough to bubble, for 5 minutes; pour off the stain and add picric acid alcohol for 4–5 seconds (1 part saturated aqueous solution of picric acid to 1 part 95 p.c. alcohol, wash with 60 p.c. alcohol, treat with 15 p.c. nitric acid till yellow (not more than 30 seconds); counterstain with picric acid alcohol till lemon-yellow. Wash with distilled water and dry. Schulte-Tigges' method is almost as efficient as Spengler's, but is more difficult to perform. Spengler's is much more satisfactory than the first and takes half the time to perform. G. M. F.

Cytology.

Cytoplasmic Inclusions.—K. B. LAL ("Cytoplasmic Inclusions in the Eggs of Certain Indian Snakes," *Quart. J. Micr. Sci.*, 1933, **76**, 243–56, 1 pl.). The eggs of four species of Indian snakes were examined, *Zamenis mucosus, Gongylophis conicus, Tropidonotus stolatus*, and *T. piscator*. In all the origin and behaviour of the cytoplasmic inclusions was not dissimilar. Golgi bodies are juxtanuclear in the early stages after which they migrate towards the cortex, getting finally dispersed in the cytoplasm. In general the individual Golgi elements have a lightly staining centre surrounded by a heavily impregnated rim. Sometimes they also appear as crescents in section. The Golgi bodies are present in the theca and the follicle cells of the oocyte and periodically "infiltrate" inwards into the cortical region. Mitochondria are feebly developed and whenever met with are granular in early stages and dust-like and more peripheral in advanced oocytes. Fatty yolk is short-lived and is formed in the cytoplasm under the influence of a number of Golgi bodies. Albuminous yolk appears late in the development of the oocyte. It arises in the cytoplasm, sometimes in vesicles and sometimes in association with mitochondria in the peripheral region. G. M. F.

The Cultivation of Monocytes in Fluid Medium.—L. E. BAKER (*J. Exp. Med.*, 1933, **58**, 575–83, 1 pl.). Monocytes of chick embryo from blood and spleen were cultivated in fluid medium in Carrel flasks for over 2 months. Diluted serum

supplied all the essential nutritive substances. Cultivation in fluid was made possible by adjusting the initial pH of the fluid to 7·4 and not allowing it to fall below 7·0 or 6·8. The cells remained in good condition when the pH was adjusted with either lactic acid, hydrochloric acid, or carbon dioxide. Adjustment with carbon dioxide was the most convenient as the buffer action of the medium is not destroyed. After 2 months the cells were in good condition and gave every indication of being able to maintain indefinite proliferation.   G. M. F.

Central Body Structure in Chætopterus.—H. J. FRY ("Studies of the Mitotic Figure. III. Chætopterus: Central Body Structure at Metaphase, First Cleavage, after using Diluted Fixatives," *Biol. Bull.*, 1933, **65**, 207–37, 1 pl.). The structure of central bodies in Chœtopterus eggs at metaphase, first cleavage, was studied after fixation with 116 reagents, which represent forty-eight different combinations of chemical components. Centrioles are demonstrated by only four of the combinations, composed of one or more of the organic substances, acetic acid, picric acid, formaldehyde, and alcohol. The only component present in all four is acetic acid. In the case of the four effective combinations the components must be present within very small and narrowly limited amounts, differing in the case of each combination and requiring a dilution of the usual reagent with 70–95 parts of water. Dilution with sea water is more effective for demonstrating centrioles than distilled. Various types of central bodies were demonstrated, each associated with a specific astral configuration which varies as to the coarseness and shape of the rays.   G. M. F.

Vital Staining.—R. J. LUDFORD ("Vital Staining in Relation to Cell Physiology and Pathology," *Biol. Rev.*, 1933, **8**, 357–69, 2 text-figs.). Certain acid dyes (e.g. trypan blue) are segregated by many living cells in the form of droplets or granules. Segregation *in vivo* has been shown to be influenced by the rate of diffusion of dyestuffs; but experiments carried out *in vitro* do not afford evidence of any relationship between segregation and rate of diffusion of dyes. Recent researches indicate that the state of functional activity of cells and also the chemical constitution of the dyestuffs may be of fundamental importance. Only rarely are preformed cell inclusions stainable with acid dyes, but most cytoplasmic vacuoles (not fat droplets) and many kinds of granules are stainable with basic dyes, such as neutral red and brilliant cresyl blue. Such staining is evidently the result of the flocculation of the dye by the more acid cytoplasmic inclusions. This type of staining has been shown to be influenced by the state of functional activity of the cells. Basic dyes can also be segregated like acid dyes, but the process does not occur under anærobic conditions. Janus green is the only dye which has been shown to stain mitochondria universally. The living nucleus apparently only stains under special metabolic conditions. In some cells of a secretory or excretory function the segregation of dye seems to be brought about by the Golgi apparatus. Basic dyes, which are readily soluble in lipins and not flocculated in contact with acid colloids (e.g. rhodamine B), stain cells diffusely. Other basic dyes (e.g. neutral red) have also been found to stain living cells diffusely in certain states of functional activity (e.g. anærobiosis). Acid dyes have been found to stain cells diffusely under abnormal conditions (e.g. action of thorium X and benzol) besides staining dying and dead cells.   G. M. F.

The Movements of Water in Living Organisms.—D. J. LLOYD (*Biol. Rev.*, 1933, **8**, 463–81). The movements of water in living organisms are founded on the properties of the colloids and crystalloids present in the body. The bound water of the organism is held by the proteins and other cell colloids either by co-

ordinated links to definite chemical groupings or by electrostatic forces round charged centres. The free water is distributed through the organism by the ordinary processes of diffusion depending on solvent pressure. Both bound and free water are controlled in their distribution by the cohesive forces between the protein molecules in the different tissues. No sharp distinction can, however, be drawn between " bound " and " free " water. The distribution of both bound and free water between an organism and its environment is controlled in the first place by the ordinary physical laws of evaporation, diffusion, and so on. Living organisms can, however, by the expenditure of energy, maintain inequalities in the distribution level of both water and dissolved salts between body fluids and environment. G. M. F.

The Group of Common Fibroblasts.—R. C. PARKER (" The Races that Constitute the Group of Common Fibroblasts. III. Differences determined by Origin of Explant and Age of Donor," *J. Exp. Med.*, 1933, **58**, 401–14). The ability of common connective tissue cells to multiply in a given environment depends not only on the nutritional quality of the latter but also on the inherent capacities of the cells themselves. Fibroblasts, as a group, comprise many cell races. Each race manifests certain specific functional properties when cultivated *in vitro*. These properties differ according to the age of the individual and also according to the particular organ or tissue from which the strain is derived. They are displayed in the relative abilities of the various races to live and reproduce in a given environment, to produce changes in the acidity of that environment, and to digest fibrin. The functional differences are permanent. G. M. F.

Mucus Formation in Goblet Cells.—E. S. DUTHIE (*Proc. Roy. Soc. B.*, 1933, **113**, 459–63, 6 text-figs.). The origin of secretory granules in goblet cells occurs at the cell base, probably in relation to the mitochondria. Emigration into the Golgi areas occurs where the transformation into stainable mucin takes place. The whole process is in every way similar to that occurring in other gland cells, particularly those of the mucous salivary glands. G. M. F.

Cytological Changes in the Lachrymal Gland.—J. BEATTIE and P. R. McDONALD (" Cytological Changes in the Lachrymal Gland following the Administration of Certain Drugs," *Proc. Roy. Soc.*, B, 1933, **113**, 217–25, 2 pl.). There are two separate secretory units within the lachrymal gland of the cat—the alveoli and the secretory ducts. The alveoli react to pilocarpine, acetyl chloine, and physostigmine by undergoing extensive vacuolation without loss of mitochrondia. The secretory ducts never show vacuolation by any method of stimulation. Their granular material disappears during stimulation and is reconstituted again mainly around the nuclear membrane. The secretions caused by histamine and pituitrin are due to the activity of contractile elements around the alveoli and secretory ducts. The drugs which reproduce the effects of nerve stimulation are acetyl chloine and physostigmine and are therefore truly parasympathetico-mimetic for the lachrymal gland. G. M. F.

Arthropoda.

Hydracarina.

Wisconsin Hydracarina.—RUTH MARSHALL (" Preliminary List of the Hydracarina of Wisconsin. Part III," *Trans. Wisc. Acad. Sci. Arts Lett.*, 1933, **28**, 37–61, pls. 1–4). Adds twenty-two species of Unionicola and Neumania to the lists published in Parts I and II. Author is of the opinion that *Unionicola sayi* Piers. should be suppressed in favour of *U. aculeata* (Koen.) and *U. haldemani*

Piers.˙ in favour of *U. ypsilophora* (Bonz) as the minor differences which exist between the related forms are not in her opinion sufficient justification for Piersig's species. Faust's account of *U. aculeata* is challenged on the ground that his material was evidently *U. abnormipes* (Wolc.). The male of *Neumania semicircularis* Mar. is now recognized and figured. *N. muttkowski* Mar., *N. okobojica* Mar., *N. brevibrachiata* Mar. are now declared by author to be invalid, material so designated being found on re-examination to be referable to earlier named species. *N. hickmani* is described as a new species while previous descriptions or figures of *N. tenuipalpis* Mar., *N. punctata* Mar., and *N. fragilis* Mar. are amended in this communication. BM/HNDH

Water Mites from the Netherlands.—A. J. BESSELING ("Nederlandsche Hydrachnidæ," *Tijdschrift voor Entomologie*, 1932, Deel LXXV, Supplement 141–8). Lists the watermites for Holland with synonymic notes. (*Entomologische Berichten,* 1931, Deel VIII, no. 182, 303–5). Discusses the variability to be found in *Sperchon setiger* Thor. (*Idem,* 1932, no. 183, 337–8). Describes *Neumania imitata* Koen. (*Idem,* no. 184, 371–5). Deals with the genus *Atractides* Koch.; and also (375–8) describes and figures *Aturus oudemansi* as a new species. (*Idem,* no. 186, 398–400). Discusses *Forelia parmata* Koen. (*Idem,* no. 188, 434–9). Reviews the subgenus *Pilolebertia* Thor. (*Idem.* 1930, no. 173, 84–5). Describes as a new species *Feltria romijni,* of which no figures are given. BM/HNDH

Rotifera.

Sand-dwelling Rotifers.—JERZY WISZNIEWSKI (VIGRI) ("Les rotifères des rives sablonneuses du Lac Wigry," *Arch. d'Hydrobiol. d'Ichthyol.,* 1932, **6**, 86–100, 2 pls.). From numerous stretches of wet sand on the banks of Lake Vigri in particular, of eight neighbouring lakes, and of the River Bug, some 180 samples were taken and carefully examined and in the result found to be so rich in rotifer life that the author was able to compile the now published list of fifty-seven species of rotifers occurring in this habitat. The sandy stretches in question lay just above the water level in their respective localities, *i.e.* between that level and the edge of the herbage on the higher portions of the banks and were kept wet by the water drawn up by the capillarity of the sand-grains. A habitat of this description does not seem to have been systematically searched by any earlier worker. From their preponderance in the list the notommatid rotifers appear to have a special affinity for such quarters; twenty-five of the species found belonged to this family, while of the five species of notommatids described as new to science four are stated to be either common, or moderately so, in these gatherings. The rare species is *Wigrella depressa* n.g., n.sp. of which only five examples were obtained. It is a dorso-ventrally flattened form of moderate size, which in dorsal aspect has somewhat of the appearance of one of the Euchlanidæ and in lateral view that of a Dicranophorus, while its jaws are distinctly of the Encentrum type. *Dicranophorus hercules* n.sp. and *D. capucinoides* n.sp. are clearly of the major type of their genus and the former is of good size (length 440μ–520μ) and both have well-developed trophi. *Encentrum sabulosum* n.sp. and *Encentrum velox* n.sp. are elongate species of the type of *Encentrum elongatum* (Glascott) and of *Encentrum ricciæ* Harring (if the latter be really distinct from Miss Glascott's form). *Diurella pygocera* n.sp. is a plump˙ little species said to be nearly related to *Diurella taurocephala* Hauer, which also occurred in the sands of the River Bug and whose male is now described. *Monostyla psammophila* n.sp. is stated to resemble *M. obtusa* Murray, the principal distinction being in the form of the toe and of the claw.

These are figured for both species and a description is also given for a male which is believed to be that of the new Monostyla. In addition to the males already noted, descriptions and figures are given for the males of *Dicranophorus capucinoides*, *Encentrum velox*, *Lepadella patella*, and of *Colurella colurus*. A variety of the puzzling *Elosa worrallii* Lord, having a small mucron on the ventral surface just behind a semi-lunar opening in the lorica at right angles to the body axis and opposite to the anus, is given the name of var. *spinifera*. D. L. B.

Protozoa.

Holozoic Nutrition in Euglena.—R. P. HALL ("The Question of the Ingestion of Solid Particles by *Euglena*," *Trans. Amer. Micr. Soc.*, 1933, **52**, 220). The author repeated the observations of Kent and of Tannreuther, according to whom *Euglena* is capable of ingesting carmine particles and powdered Indian (Chinese) ink respectively. Powdered ink was added to cultures of *Euglena* and samples were examined from 10 minutes to 72 hours later. At low power it appeared that the ink particles were inside the cytoplasm, but when observed under immersion it was obvious that the particles adhered to the surface of the flagellates. As regards carmine, it is possible that reddish pigment granules often present normally in the cytoplasm of *Euglena*, may have been misinterpreted by Kent as ingested particles. C. A. H.

Intestinal Flagellates from Marmots.—H. B. CROUCH ("Four New Species of *Trichomonas* from the Woodchuck (*Marmota monax* Linn.)," *J. Parasitol.*, 1933, **19**, 293, 1 pl.). The first record of trichomonad flagellates from the intestine of an American rodent, the woodchuck, *Marmota monax*. The following four new species have been created : *Trichomonas wenrichi*, *T. digranula*, *T. marmotæ* *T. cryptonucleata* spp.n. A description of each, illustrated by figures in a plate, is given. One of these flagellates, *T. wenrichi*, was found to be invaded by a coccus-like parasite, to which the name *Sphærita trichomonadis* sp.n. is given. C. A. H.

New Flagellates from Termites.—W. W. LEWIS ("New Species of *Proboscidiella* and *Devescovina* from *Kalotermes occidentis* Walker, a termite of Lower California," *Univ. Calif. Publ. Zool.*, 1933, **39**, 77, 3 pls., 1 text-fig.). A detailed description of two new Oxymonad flagellates from a Californian termite, *Kalotermes occidentis*. In *Proboscidiella occidentis* sp.n. the average number of nuclei is 5·5, the two blepharoplasts in each mastigont are connected by a hyaline bar, and each gives rise to a pair of long flagella. *Devescovina polyspira* sp.n. has an unusual parabasal which is often split, dividing distally into as many as six to eight strands ; at the distal end there is a fibrillar, hyaline axostyle with a terminal expansion and a siderophile muff. C. A. H.

Morphology of Astomatous Ciliates.—M. BUSH ("The Morphology of the Ciliate *Haptophrya michiganensis* Woodhead and its Relation to the Other Members of the Astomatea," *Trans. Amer. Micr. Soc.*, 1933, **52**, 223, 2 figs.). Brief description of the neuromotor apparatus of *Haptophrya michiganensis*, an astomatous ciliate parasitic in the intestine of *Hemidactylium scutatum*, together with an account of the comparative morphology of the Astomatea. In place of the absent mouth *Haptophrya* is provided with a sucker, and its neuromotor system is modified accordingly. The motorium occupies a central position and is connected with the fibrillar ring by radial connectives. The fibrillar ring is homologous to the circumœsophageal ring of the other ciliates. In the part dealing with the

comparative morphology of other Astomatea the following elements are briefly dealt with : form and size, cilia, ectoplasm and endoplasm, skeleton, contractile vacuole, nuclei, and cysts.   C. A. H.

Pure Culture of Paramæcium.—R. W. GLASER and N. A. CARIA (" The Culture of *Paramecium caudatum* free from Living Micro-organisms," *J. Parasitol.*, 1933, **20**, 33). Description of a new method for the cultivation of *Paramœcium caudatum* in a medium free from living micro-organisms. The medium consists of (1) liver extract, (2) killed yeast, and (3) rabbit kidney. It is prepared as follows : (1) To 100 c.c. sterile tap water is added 0·5 gm. of liver extract (Eli Lilly Co.'s No. 343). The solution is filtered successively through paper and a Berkefeld " N " filter and distributed into sterile test-tubes, 10 c.c. in each. Its reaction is pH 6·2–6·4. The following can be substituted for the commercial liver extract : To 100 gm. of finely ground rabbit, beef, or swine liver are added 200 c.c. sterile tap water ; the suspension is infused overnight in a refrigerator, filtered through cotton, and heated over a water bath for about 1 hour ; the supernatant fluid is centrifuged and brought to 400 c.c. with tap water ; it is then warmed to about 60° C., passed through Berkefeld candles " V " and " N," and distributed in quantities of 10 or 22 c.c. into sterile test-tubes. The reaction of the rabbit liver extract was pH 6·4–6·6, while that of beef and swine was pH 6·8–6·9. (2) Baker's yeasts grown for 5 days on dextrose agar were washed off with sterile water and centrifuged twice ; the washed yeasts were suspended in 15 c.c. sterile tap water and poured into tubes, 5 c.c. to each ; the tubes were sealed and placed in a water bath for 30 minutes at 75°–80° C. Instead of yeast, killed cultures of *Staphylococcus* may be used. (3) Pieces of kidney weighing 2–3 gm. are transferred from freshly killed rabbit to tubes of liver extract, with sterile precautions. The ciliates used for the culture were grown with living yeast in potato water ; they were then centrifuged and washed three times in sterile water, transferred to the bases of long pipettes and allowed to migrate by negative geotropic action through a column of sterile tap water. By this method (described in detail in a previous paper, *J. Exp. Med.*, 1930, **51**, 787) the paramæcia can be freed of the yeasts in 4 days. To each tube of liver extract plus kidney is added 0·1 c.c. yeast suspension and ciliates ; on the second and fourth days of incubation a further 0·1 c.c of yeasts is added. Growth reaches its maximum by the tenth day at about 25° C., and cultures have been maintained for periods up to 6 months, subinoculating about once a week.   C. A. H.

Intestinal Infusoria of the Indian Ox.—C. A. KOFOID and R. F. MAC-LENNAN (" Ciliates from *Bos indicus* Linn. III, *Epidinium* Crawley, *Epiplastron* gen. nov., and *Ophyroscolex* Stein," *Univ. Calif. Publ. Zool.*, **39**, 1933, 1 pl., 5 text-figs.). A revision of the oligotrichous genera *Epidinium* and *Ophyroscolex* based on members of these genera parasitic in the stomach of the Indian ox, *Bos indicus*. The genus *Epidinium* is restricted to those species which possess three skeletal plates, while a new genus *Epiplastron* is created for the ones in which the skeleton is composed of five plates, with *E. africanum* (Dogiel, 1925) as type-species. A new species is described for *Ophyroscolex*, *O. spinosus* sp. n. The paper is illustrated by fifteen figures.   C. A. H.

New Name for Diplodinium hegneri.—E. R. BECKER (" Concerning *Elytroplastron hegneri* Becker and Talbott, 1927," *Trans. Amer. Micr. Soc.*, 1933, **52**, 217, 1 text-fig.). In 1927 Becker and Talbott described a new oligotrichous ciliate from cattle under the name *Diplodinium hegneri*. This species comprised

three forms, one of which was assigned by Kofoid and MacLennan (1932) to *Ostracodinium obtusum*. The present author identifies another form of *D. hegneri* with *Elytroplastron bubali* Dogiel, 1928, the correct name and synonymy of the former thus being as follows : *Elytroplastron hegneri* (Becker and Talbott, 1927) Becker, 1933. Synonyms: *Diplodinium hegneri* Becker and Talbott, 1927 ; *D. (Polyplastron) bubali* Dogiel, 1928 ; *D. (P.) longitergum* Hsiung, 1931 ; *Elytroplastron bubali* (Dogiel, 1928) Kofoid and MacLennan, 1932. C. A. H.

New Bird Coccidium.—E. A. ALLEN (" *Eumonospora tremula* gen. et sp. nov., a Coccidium from the Intestine of the Turkey Buzzard, *Cathartes aura septentrionalis* Wied," *Trans. Amer. Micr. Soc.*, 1933, 52, 192, 2 figs.). Under the name *Eumonospora* gen.n. *tremula* sp.n., the author describes a new coccidium recovered from the intestine of the turkey buzzard (*Cathartes aura septentrionalis*). The new genus possesses the chief diagnostic characters of the genus *Caryospora*, i.e. oocysts with a single sporocyst containing eight sporozoites, but differs in shape of the oocyst and sporocyst, in the absence of a micropyle in both these structures, and in the arrangement of the sporozoites. [These peculiarities are not of sufficient importance to justify the separation of the new coccidium into a new genus, but it evidently represents a new species of *Caryospora*.] C. A. H.

Classification of Myxosporidia.—R. KUDO (" A Taxonomic Consideration of Myxosporidia," *Trans. Amer. Micr. Soc.*, 1933, 52, 195). A brief revision of the system of classification of the Myxosporidia and a list of all the genera and species of this order of Cnidosporidia, with brief diagnoses of the various groups. The following new groups are created : Wardiidæ fam.n., Unicapsulidæ fam.n., *Thelohanellus* gen.n. There is a lengthy bibliography, exclusively of papers which appeared after 1920, the previous ones having been listed in the author's monograph of that year. C. A. H.

The Genus Gümbelina.—J. A. CUSHMAN (" Post-Cretaceous Occurrence of *Gümbelina* with a Description of a New Species," *Cont. Cush. Lab. For. Res.*, 1933. No. 135, 64–9, figs. 15–6 on pl. 7). The genus *Gümbelina* is very abundant and a typical fossil of the Upper Cretaceous. Specimens are often found in Tertiary and recent deposits and their appearance is usually held to be due to the denudation of Cretaceous deposits. The author discusses some Tertiary records which he considers proof that the genus persisted to nearly the top of the Eocene, and describes a new species *Gümbelina goodwini* from the Upper Eocene of Trinidad. A. E.

D'Orbigny's Models.—J. A. CUSHMAN (" Some Notes on D'Orbigny's Models," *Cont. Cush. Lab. For. Res.*, 1933, no. 136, 70–3). The famous Models which were issued in 1826, were recast and reissued in 1843 with a revised pamphlet, which is now rare. Its chief value lies in the details of the localities from which the specimens selected as models were obtained, which were often not indicated definitely in D'Orbigny's earlier work (1826). For this reason the 1843 description of the Models is reprinted in full. A. E.

Two New Genera and their Relationships.—J. A. CUSHMAN (" Two New Genera, *Pernerina* and *Hagenowella*, and their Relationships to Other Genera of the Valvulinidæ," *Amer. J. Sci.*, 1933, 26, 19–26, pl. i–ii). The new genus *Pernerina* is based on a Cenomanian fossil *Bulimina depressa* Perner, 1892. *Hagenowella* is based on *Valvulina gibbosa* d'Orbigny, 1840, originally described

from the Chalk of Paris and known also from English chalk. The bulk of the paper consists of a phylogenetic discussion of the evolution and relationships of the various genera included by the author in his family Valvulinidæ.　　A. E.

New Cretaceous Foraminifera.—J. A. CUSHMAN (" New American Cretaceous Foraminifera," *Cont. Cush. Lab. For. Res.*, 1933, no. 134, 49–64, pls. 5–7). Twenty-seven new species and varieties of Foraminifera from the Upper Cretaceous of the Gulf Coastal Plain region of the U.S.A. are described and figured in anticipation of a Geological Survey report now in course of preparation. It is stated that many of the forms have a relatively short vertical range in the American Cretaceous, and will be found useful as markers for their particular parts of a section.　　A. E.

Fenland Foraminifera.—W. A. MACFADYEN (" Report on the Silts and Clay" in " Report on an Early Bronze Age Site in the South Eastern Fens " (Grahame Clark), *Antiquaries J.*, 1933, **13**, no. 2, 289–92). The author examined material from seven borings made in the Fenland about seven miles E.N.E. of Ely. He lists forty species and varieties of Foraminifera which may be regarded as indigenous, i.e., living in the deposits when they were laid down. Five other species of Foraminifera were observed which are derived fossils from the chalk, chalk spheres also occurring in six of the samples. One fossil species derived from the Jurassic was also noted. The three uppermost samples were Buttery Clay (Post Glacial), the remainder were Post Glacial silts. Of the clays the topmost sample contained relatively few Foraminifera, all of the most brackish water type; the other samples of clay contained more abundant Foraminifera, some of which are less tolerant of low salinity. The whole bed of Buttery Clay therefore seems to indicate a transition from semi-marine silty clay to nearly freshwater siltless clay. The four samples of silts appear to have been deposited from tidal estuarine water flowing up an ancient waterway, and are of more nearly marine nature than the Buttery Clay, which was deposited in adjoining lagoons but not in the actual waterway. This is proved by the greater abundance of the more marine species of Foraminifera in the silts. One sample of silt contains an admixture of estuarine and marine Foraminifera with fragments of freshwater Mollusca, and probably represents a mixture of debris brought down by a river with other material brought up by the tide.　　A. E.

Foraminifera of Texas.—F. B. PLUMMER (" The Geology of Texas. Vol. I. Stratigraphy. Part 3. Cenozoic Systems in Texas," *Univ. Texas Bull.* 3232, 1933, 519–818, pls. 7–10, text-figs. 28–54). Scattered throughout this elaborate report on the Tertiary deposits of Texas are lists of the typical Foraminifera found in the various formations, compiled by Mrs. Helen J. Plummer. They contain much valuable information as to the associations, distribution, and frequency of the various species. A few of the more typical fossil Foraminifera are figured on Plate VII.　　A. E.

Ultramicroscopic Viruses.

Herpetic Intranuclear Inclusions.—L. E. RECTOR and E. J. RECTOR (" The Microincineration of Herpetic Intranuclear Inclusions," *Amer. J. Path.*, 1933, **9**, 587–92, 1 pl.). Microincineration of herpetic intranuclear inclusions from the cerebral cortex of rabbits reveals the presence of considerable inorganic material in young full inclusions with a progressive decrease in amount as the inclusions

develop. Mature inclusions are frequently devoid of any inorganic residue. This disappearance of inorganic material might be due to a change in the permeability of the nuclear membrane or to conversion of the inorganic content from a comparatively non-dialysable form in young inclusions to a highly dialysable form in older inclusions. Possibly the heavier ash content of the young inclusions may be due to chromatin that has not migrated to the periphery of the nucleus.

G. M. F.

Infectious Warts in Rabbits.—R. E. SHOPE and E. W. HURST (" Infectious Papillomatosis of Rabbits. With a Note on the Histopathology," *J. Exp. Med.*, 1933, 58, 607–24, 3 pl.). Papillomata have been observed in wild cottontail rabbits and has been found to be transmissible to both wild and domestic rabbits. The clinical and pathological pictures of the condition are described. The causative agent is readily filtrable through Berkefeld but not regularly through Seitz filters. The disease is transmissible in series through wild rabbits but cannot be transmitted in series through domestic rabbits.

G. M. F.

Neuro-paralytic Accidents in Rabies.—S. GETZOWA, G. STUART, and K. S. KRIKORIAN (" Pathological Changes observed in Paralysis of the Landry Type : A Contribution to the Histology of Neuro-paralytic Accidents Complicating Antirabic Treatment," *J. Path. & Bact.*, 1933, 37, 483–500, 4 pls.). The predominant feature in two cases of Landry's paralysis following antirabic treatment and in one case of unknown origin is a widespread lesion of ganglion cells inducing the occurrence of a rapidly advancing fatal paralysis. There is a total absence in the central nervous system of perivascular zones of demyelinization and of perivascular cuffing. Antirabic treatment cannot, therefore, be included among the various factors (small-pox, vaccinia, measles, varicella, and typhoid) capable of producing acute disseminated encephalomyelitis (Westphal). A virus theory is contraindicated. So far as " accidents paralytiques " are concerned there seems in the basic nerve substance of all antirabic vaccines to exist some deleterious component which, though adversely affected by various physical and chemical agencies, is still capable, in peculiarly susceptible individuals, of producing neuro-paralytic disorders.

G. M. F.

The Size of the Virus of Louping-Ill.—W. J. ELFORD and I. A. GALLOWAY (" The Size of the Virus of Louping-ill of Sheep by the Method of Ultrafiltration Analysis," *J. Path. & Bact.*, 1933, 37, 381–92). The size of the virus of louping-ill has been estimated to be 15–$20\mu\mu$ by the method of ultrafiltration analysis using graded collodion membranes.

G. M. F.

Growth Phases of Pleuropneumonia and Agalactia.—J. C. G. LEDING-HAM (" The Growth Phases of Pleuropneumonia and Agalactia on Liquid and Solid Media," *J. Path. & Bact.*, 1933, 37, 393–410, 4 pl.). The morphology and growth phases of pleuropneumonia and agalactia have been studied in liquid and solid media and the conclusion is reached that these organisms may be placed provisionally in the Order *Actinomycetales* Buchanan 1918 and in the family Actinomycetaceæ of that Order.

G. M. F.

Intranuclear Inclusions in Fox Encephalitis.—R. G. GREEN, M. S. KATTER, J. E. SHILLINGER, and K. B. HANSON (" Epizootic Fox Encephalitis. IV. The Intranuclear Inclusions," *Amer. J. Hyg.*, 1933, 18, 462–81, 13 text-figs.). The inclusion bodies were found in the brains of foxes inoculated by intracranial, intramuscular and intratesticular injections in the nuclei of endothelial cells of

blood-vessels. After infection of vines by cisternal puncture intranuclear inclusions were also found in the ependymal cells. In elongated endothelial cells the inclusions are usually fusiform, but the endothelial nucleus sometimes balloons out and the inclusion body is then somewhat spherical. A margination of the nuclear chromatin is sometimes evident. The staining reactions of the inclusions are described. Most of the inclusions show a deeper staining central part.

G. M. F.

The Histology of Pseudorabies (Mad Itch).—E. W. HURST ("Studies on Pseudorabies (Infectious Bulbar Paralysis, Mad Itch. I. Histology of the Disease, with a Note on the Symptomatology," *J. Exp. Med.*, 1933, **58**, 415–433, 3 pls.)). The histology of pseudorabies differs in various animal species. In the rabbit subcutaneous, intradermal, or intramuscular inoculation leads to local inflammation and necrosis. The infection ascends the peripheral nerve, possibly both interstitially and by the axis cylinders, to the corresponding spinal ganglia and segments of the spinal cord, where primary degeneration of nerve and glial cells takes place. The nerve cell changes are probably responsible for the cardial symptom of the disease, itching. Death ensues soon after virus reaches the medulla, before visible changes have been produced here. Intracerebral inoculation is followed by lesions in the meninges, subpial glial cells, and in superficially placed nerve cells. Morbid changes in the lungs are not necessarily related to the presence of virus but specific lesions may be present. Intranuclear inclusions bearing some resemblance to those in herpetic encephalitis occur in cells derived from all embryonic layers. The disease in the guinea-pig is similar to that in the rabbit, modified only by the slightly greater resistance of the animal. In the monkey after intracerebral inoculation, widespread degeneration and necrosis of cortical nerve cells are accompanied by specific nuclear alterations in nerve and glial cells, but not in cells of mesodermal origin. No lesions are found in other viscera. In the spontaneous disease in the cow lesions approximate more closely to those in the monkey than to those in the rabbit. In the pig vascular and interstitial lesions predominate, nerve cell degeneration is slight, and typical inclusions are not observed. These differences probably explain the benign course of the malady following subcutaneous inoculation in this animal. The lymphatic system also participates in the reaction to the virus.

G. M. F.

The Rôle of Embryonic Cells in the Culture of the Virus of Fowl Plague. —H. PLOTZ ("Rôle des cellules embryonnaires dans la culture du virus de la peste aviaire," *C. R. Acad. Sci.*, 1933, **197**, 536–7). It is suggested that in tissue cultures of viruses the cells function as regulators of potential and that the rôle of oxygen thus consists in maintaining a constant oxidation reduction level. The substitution of other substances for oxygen, such as indigo tetrasulphonate, disulphonate, or monosulphonate allows the virus to multiply in the absence of oxygen. Methylene blue and Nile blue, which penetrate the cells, inhibit the multiplication of the virus.

G. M. F.

BOTANY.

Cytology.

Amphidiploidy in Erophila verna.—Ö. WINGE ("A Case of Amphidiploidy within the Collective Species *Erophila verna*," *Hereditas*, 1933, **18**, 181–91). By crossing two types (œcospecies) of *Erophilaverna* with fifteen and thirty-two chromosomes in the haplophase, respectively, a semi-sterile F_1 is obtained. This F_1 produces, by a semi-heterotypic division, partly diploid gametes, from which originates an amphidiploid constant hybrid with n = 47. This confirms the view that the *Erophila* microspecies biologically really behave as a series of Linnean species for, within the (cœno-) species *E. verna* are found phenomena similar to those which may be found on crossing plants belonging to different species.

J. S.

Genetics of Papaver.—Ö. WINGE ("Experiments with *Papaver Rhœas* L., *F. strigosum* Bœnn.," *Bulletins of the Laboratory of Genetics*, 1932, **9**, 115–20). *Papaver Rhœas f. strigosum* is dominant over the common form of *P. Rhœas* which has spreading hairs on the peduncle. The recessive type is peculiar in that it has a tendency to segregate in a slightly excessive number, the 3 : 1 segregations showing a count of 897 appressed-haired : 315 spreading-haired plants, whereas the 1 : 1 segregations showed 4463 appressed : 5120 spreading. A connection is shown between the flowering time and the hair type; the appressed-haired type flowers relatively earlier. Probably the fact that the recessive type is most common in Nature is explained by its higher vitality.

J. S.

Amphidiploid Derivatives in Nicotiana.—W. E. LAMMERTS ("The *Nicotiana rustica-paniculata* Amphidiploid Derivatives," *Cytologia*, 1932, **4**, 46–51). Amphidiploid plants combining the diploid chromosome numbers of *N. rustica* (24 bivalents) and *N. paniculata* (12 bivalents) were obtained in the F_2 by the union of diploid gametes from the F_1 hybrid of *rustica* × *paniculata*. This hybrid shows the *Drosera* type of pairing during the first metaphase of the reduction division, there being $12_{II} + 12_{I}$. The amphidiploid plants showed a variable number of quadrivalents at the first metaphase, and accordingly by continuous selfing gave rise to distinctive true breeding derivative lines most of which have seventy-two chromosomes. These uniform lines indicate that dissociation of quadrivalents in the original F_2 plants was not strictly preferential and that complete substitution is possible in some quadrivalents at least. In one line three haploid plants were found. These had the following chromosome complements : $12_{II} + 12_{I}$, $11_{II} + 13_{I}$, and $10_{II} + 1_{IV} + 12_{I}$, and are comparable to the haploids obtained by Jørgensen from *Solanum nigrum* (36_{II}).

J. S.

Chromosomes in Rosa.—E. W. ERLANSON ("Chromosome Pairing, Structural Hybridity, and Fragments in *Rosa*," *Bot. Gaz.*, 1933, **94**, 551–66). Multiple pairing of chromosomes due to reduplication and reciprocal translocation of segments has been found in diploid roses belonging to the species complexes *Rosa*

multiflora, R. blanda, R. Woodsii, and *R. pisocarpa.* Gametes with eight chromosomes are sometimes produced, but no diploid has been found possessing a reduplicated whole chromosome. A plant of *R. pyrifera,* previously reported as 2n = 16, has a small unequal pair which are really reduplicated homologous fragments of approximately half a chromosome. They pair with each other and with two different pairs. In a number of cases both fragments fail to pair. The larger, f[1], consists of two segments, homologous with two different pairs. This reduces its pairing frequency to less than that of the shorter fragment, f. This is the only example of fragments yet found in *Rosa.* Among tetraploid roses multivalent associations of chromosomes are frequent, but are rare in hexaploids and octoploids. Triploids with a high proportion of trivalents have been found in diploid cultures of *R. blanda, R. Macounii,* and *R. pisocarpa.* These probably originated from unreduced gametes and arose without hybridization. The unbalanced tetraploid *R. villosa* shows a high chiasma frequency among fourteen chromosomes, and a very low frequency among the other fourteen which often occur as univalents. Trivalents were found in eight nuclei out of twenty. Failure of pairing of the chromosomes is probably due to differential precocity in prophase development, not to hybridization. The types of structural change and the different kinds of polyploids found in *Rosa* are described. The exceptional types of pairing are in conformity with the chiasma theory and are in three cases, such as would be predicted on that theory.   J. S.

Chromosome Numbers in Hieracium.—A. H. GUSTAFSON ("Cytological Studies in the Genus *Hieracium,*" *Bot. Gaz.,* 1933, 94, 512–33). The following results were obtained from a study of microsporogenesis in species of *Hieracium. H. venosum, H. paniculatum,* and *H. scabrum* of the subgenus *Stenotheca* have the diploid chromosome number of 18 and show perfectly normal reduction divisions. *H. canadense, H. murorum,* and *H. smolandicum* of the subgenus *Euhieracium* are triploid species (2n = 27). Various degrees and combinations of non-pairing, lagging, extrusion, semiheterotypic division, polycary, polyspory, and pollensterility are found. *H. pratense* of the subgenus *Pilosella* is a tetraploid species (2n = 36) and shows lagging and extrusion in meiosis. *H. flagellare* of the same subgenus is a polyploid species and reveals meiotic irregularities such as incomplete pairing, lagging, extrusion, polycary, polyspory, and marked difference in the size of the pollen grains. The species of *Euhieracium* and *Pilosella* show the cytological peculiarities of known hybrids, as well as being polyploid. Embryos are developed apomictically. The presence of taxonomic difficulty in the subgenera *Pilosella* and *Euhieracium,* together with the facts of irregular meiosis, polyploidy, and apomixis, is considered as evidence for the hybrid origin of the species of the subgenera discussed. Hybridism is regarded as one of the ways by which polyploidy arises and one of the ways by which a multiplication of species is brought about.   J. S.

Chiasma Behaviour in Anemone.—A. A. MOFFETT ("Chromosome Studies in *Anemone.* I. A New Type of Chiasma Behaviour," *Cytologia,* 1932, 4, 26–37). Chromosome numbers are listed for diploid, triploid, tetraploid, pentaploid, and hexaploid species of *Anemone.* Most of the species have a basic number of eight. *A. Hepatica,* a diploid species, has a basic number of seven (2n = 14). Somatic doubling was found in several root-tips of *A. Hepatica* and *A. vernalis* (2n = 16). The paper deals with observations on diploids only. Eight paired chromosomes can be distinguished at pachytene. The chiasma frequency at diplotene is 6·1 per bivalent. There is a fairly high percentage of terminal chiasmata per bivalent:

a parallel reduction occurs in the total number of chiasmata per bivalent and the number of terminal chiasmata per bivalent between diplotene and metaphase. Most of the bivalents have a single interstitial chiasma at metaphase. The reduction in the number of total chiasmata per bivalent and terminal chiasmata per bivalent, indicates that terminalization takes place and that the chiasmata are resolved (by slipping off) on reaching the ends of the chromosomes. This can be interpreted as due to lack of terminal affinity. If this lack of terminal affinity were combined with strong terminalization, univalents would result at metaphase although crossing over had occurred. J. S.

Chiasmata in Diploid and Triploid Hyacinthus.—L. H. A. STONE and K. MATHER (" The Origin and Behaviour of Chiasmata. IV. Diploid and Triploid *Hyacinthus*," *Cytologia*, 1932, 4, 16–25). The chiasma behaviour is quantitatively analysed in diploid and triploid *Hyacinthus*. It is shown that, while the chiasma frequency in the triploid is greater than in the diploid, and the interference between successive chiasmata is less, the length-chiasma frequency relationship is essentially similar in both. The conception of " pairing blocks " (units in which the chromomeres tend to act when becoming associated at zygotene) is applied to *Hyacinthus*, and the conditions controlling the number and extent of " pairing blocks " are discussed. It is shown that these conditions result in the medium chromosomes having a higher number of " pairing blocks " than the short or the long chromosomes. That is, in *Hyacinthus* the maximum number of " pairing blocks " is found in chromosomes of approximately 9μ long. Below this length they are too short, and above it they are long enough to encounter mechanical interference.
J. S.

Chiasmata in Triploid Tulipa.—C. D. DARLINGTON and K. MATHER (" The Origin and Behaviour of Chiasmata. III. Triploid *Tulipa*," *Cytologia* 1932, 4, 1–15). The form and behaviour of the chromosome at diakinesis in triploid tulips is quantitatively analysed. The assumptions are made, that (1) metaphase pairing of chromosomes is conditioned by chiasma formation in the chromosomes paired at pachytene, and (2) that only two of three chromosomes pair at any one point in the triploid at pachytene. Variation in the behaviour of individual chromosomes (including the occurrence of univalents) in these triploids should then be the resultant of two kinds of variation earlier described, viz. (1) variation in the length of chromosomes paired at pachytene, and (2) variation in the number of chiasmata formed in any constant length, such as may be calculated from the variation observed in chiasmata in whole configurations (bivalent or trivalent). The observed results agree closely with the expectation arrived at in this way and thus verify the assumptions made on the grounds of earlier (qualitative) observations. J. S.

Antheridia of Sphærocarpos.—B. I. NEVINS (" Cytological Studies on the Antheridia of *Sphærocarpos Donnellii*," *La Cellule*, 1932, 41, 293–334). A detailed account is given, with seventy-seven figures, of the changes which occur and the structures that are involved in the metamorphosis of the androcyte of *Sphærocarpos Donnellii* into an antherozoid. Eight haploid chromosomes are identified. Special methods are utilized for the demonstration of Golgi material. Osmiophilic platelets have been found. These are probably not mitochondria, but no theory as to their identity is advanced. Occasionally structures which resemble osmiophilic platelets have been demonstrated by methods which reveal mitochondria. There is no evidence that vacuoles are to be regarded as homologous with Golgi structures. A

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few preparations suggest a relationship between the plastidome and chondriome of young antheridia. Neither mitochondria, plastoids, vacuoles, nor osmiophilic platelets could be traced through each of the successive cell generations within the antheridium. It is, therefore, impossible to prove which of the elements might be the equivalent of the animal Golgi apparatus. J. S.

Generative Nucleus in the Pollen of Lilium.—J. O'MARA (" Division of the Generative Nucleus in the Pollen Tube of *Lilium*," *Bot. Gaz.*, 1933, **94**, 567–578). The technique for the study of the divisions of the generative nucleus is described. The nucleus is in early prophase stage when it enters the pollen tube and is ellipsoid in shape. The vegetative nucleus varies in form and usually precedes the generative nucleus in the tube. The prophase threads in the generative nucleus are thin, long, and granular, being loosely wound and twisted throughout the nucleus. At the disappearance of the nuclear membrane the chromosomes lie scattered in the cell cytoplasm and do not form upon an equatorial plate. Twelve split chromosomes are easily recognizable. There is no trace of spindle fibres. From the form of the chromosomes there is no indication of any force acting upon them at anaphase. The telophase groups loosen up to become new nuclei which closely resemble interphase nuclei of meiosis and never become so reticulate as resting somatic nuclei. Explanations for the peculiar configurations of generative cell chromosomes are presented, also a cytological explanation of the mechanism of the formation of chromosome interchanges. J. S.

Meiosis in Œnothera missouriensis.—S. HEDAYETULLAH (" Meiosis in *Œnothera missouriensis*" *Proc. Roy. Soc.*, 1933, B. **113**, 57–70). Details of meiosis in pollen mother-cells of *Œ. missouriensis* are described and figured. The leptotene is characterized by a number of irregularly running fine chromatin threads in the nucleus. The threads of the earlier leptotene gradually concentrate and bend round. The threads are then distinctly less in number than at the early leptotene stage due to an initial union taking place at one pair of free ends. The remaining free ends of the bent threads approach each other, ultimately fusing and forming circular loops. Seven of these are formed which give rise to seven free bivalent ring pairs in diakinesis. The method of synapsis is described as acrosyndesis (telosynapsis), depending on affinity of the chromomeres lying at the extremities of the chromosomes. The question of para- and telo-synapsis is discussed, and it is shown that the two methods of chromosome conjugation vary only in degree and not in kind. The nucleolus never lies near to the nuclear membrane, and certain irregularities are seen in its behaviour. The reduction division of the chromosomes is normal and no non-disjunction of chromosomes was observed.
J. S.

Histochemical Reactions of Nuclear Structures.—N. SHINKE and M. SHIGENAGA (" A Histochemical Study of Plant Nuclei in Rest and Mitosis," *Cytologia*, 1933, **4**, 189–221). Resting and dividing nuclei in a wide range of plant material were submitted to the following tests : Feulgen's nucleal-reaction method for thymus-nucleic acid, Millon's, xanthoproteic and biuret for proteins, Christeller's, Ciaccio's, and other methods for lipoids. The solution analysis method and staining according to Pappenheim-Unna's method were used as supplementary to the above. The methods of procedure are described. The following results were obtained : (1) The nuclear reticulum and chromosomes show reactions for thymus-nucleic acid, lipoids, and proteins. (2) The thymus-nucleic acid reaction is given in the spiral portion of the chromosomes. (3) The chromosomes are far more easily dissolved by lipoid solvents and nucleoprotein solvents than is the resting

nucleus. (4) The spiral portion of the chromosomes is more resistant to the action of lipoid solvents than is the matrix. (5) There is some evidence suggesting that certain material changes may take place in the nuclear components during mitosis. (6) The nucleus of *Spirogyra* sp. gives no thymus-nucleic acid reaction but a protein reaction, forming a striking contrast to other material investigated. (7) The karyolymph shows no positive result in any of the tests for thymus-nucleic acid, lipoids, or proteins, but the precipitation method suggests that there may be lipoids present. (8) The nucleolus contains lipoids but no thymus-nucleic acid. (9) The spindle fibres and phragmoplast consist mainly of proteins and lipoids in a combined form or mixed. J. S.

Independence of Chondriosomes and Nucleus.—P. F. MILOVIDOV (" Independence of Chondriosomes from Nuclear Matter," *Cytologia*, 1933, **4**, 158–73). The author briefly reviews recent work which attempts to connect the chondriosomes with nuclear matter and concludes that it must be considered just as unsound as the earlier conceptions of the nature of chondriosomes. The methods of staining technique are described in detail. The chondriosomes of the vegetative cells give a negative nuclear reaction and therefore do not contain any thymo-nucleic acid which is the most characteristic element of the cell nucleus. The absence of nuclear reaction of the chondriosomes is proved not to be due to their destruction during fixation nor to hydrolysis. The chondriosomes do not contain any " chromatin"' and have no genetic connection with the cell nucleus. J. S.

Experimentally Produced Secondary Polyploid Nicotiana.—W. E. LAMMERTS (" An Experimentally Produced Secondary Polyploid in the Genus *Nicotiana*," *Cytologia*, 1932, 4, 38–45). The origin of a new fertile derivative type with thirty bivalent chromosomes from the hybrid between *N. rustica* (24_{II}) and *N. paniculata* (12_{II}) is described. In appearance this type is very different from the parental species and from the taxonomic point of view would be considered a distinct species. The pairing of chromosomes at metaphase is variable, as many as five quadrivalents being formed. As a result, the fertility, though good, is not comparable to that of the parental species. Selfing of hybrids, diploid for one species and haploid for another, is suggested as a general method of origin of higher chromosome numbers other than those in a polyploid series. Certain difficulties in the way of explaining the origin of higher chromosome numbers by way of species crossing are discussed. J. S.

Anatomy and Morphology.

Seasonal Activity of the Cambium in Pinus sylvestris.—W. WIGHT (" Radial Growth of the Xylem and the Starch Reserves of *Pinus sylvestris* : a Preliminary Survey," *New Phyt.*, 1933, **32**, no. 2, 77–96, 2 pls.). In order to determine the order of initiation and cessation of radial xylem growth in *Pinus sylvestris* a tree was felled about every four weeks over a period of twelve months and samples for examination taken at intervals along representative branches, down the trunk, and along at least three roots from the root-system. Growth in the trunk was found to begin suddenly uniformly along its length at about the beginning of May, before the buds had burst. Growth is vigorous from May to early July, after which slow growth continues until the beginning of October. Root growth starts some weeks later than trunk growth and continues almost to the end of the trunk-growing season. Buds all over the tree begin growth about the same time, coincident with the first signs of growth in the trunk. Lignification of the new wood begins in the buds and spreads towards the proximal parts of the branches

and thence to the roots. The starch reserves in the aerial parts show a winter minimum with total absence in January. Starch is at a maximum from April to the end of July with a slight fall of short duration in May. From July to the end of December starch is slowly disappearing. B. J. R.

Cribriform Appearance of Pit-membranes.—I. W. BAILEY ("The Cambium and its Derivative Tissues. VIII. Structure, Distribution, and Diagnostic Significance of Vestured Pits in Dicotyledons," *J. Arn. Arboretum*, 1933, 14, 259–273, 4 figs., 3 pls.). It is shown that the sieve-like or cribriform appearance of the bordered pits in the vessels of the Leguminosæ and of certain other families of dicotyledons is in reality due not to perforations of the pit-membrane but to minute papillary outgrowths from the free surface of the secondary walls. The terms *vestured pits* and *vestured walls* are proposed in place of *sieve-like* or *cribriform pits*. A study of living cells in sections of differentiating xylem shows that the structures in question are formed by the cytoplasm during the later stages of the development of the tracheary elements. It is to be noted, however, that punctate appearances simulating vestured pits may be produced at times by the deposition of extraneous material in the bordered pits during post-mortem changes and particularly during the transformation from sapwood to heartwood. From the examination of 2660 species of 979 genera belonging to 152 families of Dicotyledons, vestured pits were found to occur in 25 different families of widely different affinities. They are of very general occurrence in all those families in which they do occur, and it is inferred that sporadic distributions of vestured pits are likely to be of relatively infrequent occurrence in the case of subgenera, genera, and subfamilies. The vestured condition appears to have arisen independently a number of times. It is found in the more highly specialized types of tracheary tissue and is absent in plants which have a primitive combination of structural characters in the xylem. B. J. R.

Microchemical Studies of Coal Formation.—K. OHARA ("Mikrochemische Untersuchungen an über 1800 Jahre lange aufbewahrtem Holz—ein Beitrag zur Kohlenentstehungstheorie," *Jap. J. Bot.*, 1933, 6, 393–410, 2 pls., 5 figs.). The chemical changes which take place when wood becomes transformed into coal were studied in a specimen of wood taken from a coffin over 1800 years old. The specimen consists of an outer and an inner portion. The black coal outer portion consists of compressed wood cells recalling the micro-structure of stone coal. The inner portion shows the original structure of the wood (*Castanea pubinervis*) in an almost perfect state of preservation. In the course of decomposition the middle lamella, consisting mainly of lignin, swells and contributes largely to the lignin content of the coal. The primary cell wall, consisting mainly of lignin and cellulose, is also resistant to decomposition. The more delicate secondary wall is easily decomposed. In the transitional zone between the inner and outer portion of the specimen, the tissues consist of compressed cells with brown contents due to the disintegration of the secondary walls. The tertiary wall is decidedly more resistant than the secondary wall. B. J. R.

Anatomical Structure of Chinese Woods.—Y. TANG ("Anatomical Studies and Identification of Chinese Softwoods. I," *Bull. Fan Mem. Inst. Biol.*, 1933, 4, 7, 209–68, 9 pls.). Continuing his investigations of Chinese timbers, the author has published descriptions of forty-one species belonging to twenty-four genera of Chinese gymnosperms. The descriptions cover the habit, habitat, and distribution of the tree, the general properties of the woods, and their macroscopic and micro-

scopic structure. They are illustrated by natural-size photographs showing the growth rings on a smooth cross-section and by photomicrographs of transverse, radial, and tangential sections. There is a key to the identification of the genera, based on microscopic characters. B. J. R.

Identification of Brazilian Timbers.—J. A. PEREIRA (" Contribuição para a Identificação Micrographica das nossas Madeiras," *Escola Polytech. de São Paulo, Lab. de Ensaio de Materiaes*, 1933, Bol. no. 9, 1–165, 26 figs., 52 pls.). Introductory chapters on general lines, describing the anatomical structure of wood and the technique employed for its investigation, precede the main portion of the bulletin which consists of concise descriptions in uniform tabular arrangement illustrated by photomicrographs of transverse and tangential sections, fifty times natural size. Fifty dicotyledonous woods and two conifers from the state of São Paulo are described. B. J. R.

Wood Structure of the Myristicaceæ.—G. A. GARRATT (" Systematic Anatomy of the Woods of the Myristicaceæ," *Trop. Woods*, 1933, 35, 6–48, 2 pls.). The secondary xylem presents an unusually unified structure throughout the family. The points of similarity include the presence of tanniniferous tubes, a character so distinctive as to set aside the Myristicaceæ from all other families ; the general isomorphism of the intervascular pits ; the consistent occurrence of characteristically elongate vessel-ray pit pairs, which are commonly in definite scalariform arrangement ; the more or less indistinctly bordered pits which characterize the wood fibres ; the presence of septate fibres in the immediate vicinity of the vessels ; the moderate development of paratracheal wood parenchyma ; and the regular occurrence of coarse-celled heterogeneous rays. The wood anatomy of the specimens studied lends support to Warburg's organization of the family into a number of distinct genera, rather than to De Candolle's or Bentham and Hooker's monogeneric treatment. The distinctions between most of the genera become clear when their natural geographical grouping is considered. B. J. R.

Anatomy of Indian Halophytes.—D. P. MULLAN (" Observations on the Biology and Physiological Anatomy of Some Indian Halophytes," *J. Ind. Bot. Soc.*, 1933, 12, 165–82, 10 pls.). This paper is a continuation of one in the same Journal, 11, 299. In it the anatomy of the following psammophilous halophytes is described : *Corchorus acutangulus* Lam., *Spermacoce hispida* Linn., *Launæa pinnatifida* Cass., *Scævola Lobelia* Murr., *Ipomœa Pes-capræ* Sweet, *Neuracanthus sphærostachys* Dalz., *Lepidagathis trinervis* Nees, and *Clerodendron inerme* Gaertn. Most of these species can exist in a mesophytic as well as a halophytic environment; and when this is so the anatomy of the halophytic and mesophytic forms is compared and contrasted. The greater part of the paper consists of detailed anatomical descriptions which cannot usefully be summarized, but are best studied in their original form. C. R. M.

Anatomy of Dorothy Perkins and American Pillar Roses.—M. C. CARLSON (" Comparative Anatomical Studies of Dorothy Perkins and American Pillar Roses. I. Anatomy of Canes. II. Origin and Development of Adventitious Roots in Cuttings," *Contrib. from Boyce Thompson Instit.*, 1933, 5, 313–30, 7 figs.). Cuttings of Dorothy Perkins (*Rosa Wichuraiana* × Madame Gabriel Luizet) and American Pillar (*R. Wichuraiana* × *R. setigera*) roses root in different ways. Dorothy Perkins cuttings usually root from the base of developing shoots, and not from the base of the piece of cane, but American Pillar cuttings, on the other

hand, may root from the base of the piece of cane, and scarcely ever root from the base of the shoot. The author describes in this paper the results of an anatomical comparison of these two kinds of roses carried out in order to determine why they should exhibit this difference in their mode of rooting. American Pillar canes were found to have a thicker cuticle, a larger number of vascular bundles, and a larger amount of xylem and pith than those of Dorothy Perkins. Under favourable conditions canes of Dorothy Perkins root from basal swellings consisting of parenchymatous secondary phloem. No such swellings are formed at the bases of cuttings of American Pillar roses. Root primordia arise from small groups of parenchymatous cells which become meristematic. The tissues of the adventitious roots are first differentiated when the primordium has passed into the cortex of the shoot. C. R. M.

Variations in Fibre Structure induced by Manurial Treatments.—F. TOBLER (" Weitere Beobachtungen uber die Wirkung einzelner Stoffe auf den Bau der Bastfasern," *Jahrb. f. wiss. Bot.*, 1933, **78**, 295–317, 11 figs.). *Solanum tuberosum, Linum usitatissimum, Bœhmeria nivea,* and *Salix fragilis* were treated with different inorganic manures in order to determine what influence any particular manure might have on the structure of the fibres of these species. Applications of potassium resulted in an increase in the thickness of the walls of the fibres and in their diameters. Potassium sulphate gave the most marked results. When potassium magnesium sulphate was applied the walls of the fibres increased in thickness but the diameter diminished. Potassic fertilizers containing chlorine had a similar effect. By treating potatoes with unbalanced fertilizers it is possible to cause the walls of the fibres in the stems to separate into their constituent layers. C. R. M.

Spodograms of the Urticaceæ.—H. BIGALKE (" Die Blattspodogramme der Urticaceæ und ihre Verwendbarkeit für die Systematik," *Beitrage Biol. der Pflanzen,* 1933, **21**, 1–58, 5 pls.). The author prepared spodograms of the leaves of species of all the genera of the Urticaceæ with the exception of *Petelotia.* The characters of the spodograms were found to vary from species to species, in a way that in general corresponds with the accepted classification of the family based on external morphology. The characters and distribution of the cystoliths are of the greatest taxonomic value, but the crystals and hairs are also important although to a smaller extent. Separate keys to the genera and species respectively are given. In a few instances the classification of the family based on the characters of the spodograms does not agree exactly with that based on external morphology. The author believes that this discrepancy may afford grounds for separating certain species, genera, or groups of genera into independent units, whilst in other instances doubt may be cast on the validity of some established genera. C. R. M.

Floral Development, Embryology and Anatomy of Thesium montanum Ehrh.—H. SCHULLE (" Zur Entwicklungsgesichte von *Thesium montanum* Ehrh.," *Flora,* 1933, **27**, N.S., 140–84, 13 figs.). An account of the development of the flower, fertilization, development of the embryo, and anatomy of the mature plant of *Thesium montanum* Ehrh. At the point of origin of the flower there arise in turn the five stamens, the perianth segments (usually five), and, lastly, the three carpels. The latter develop into an inferior ovary, which bears in its cavity a central placenta with three naked ovules. The green basal portion of the perianth has the same parenchymatous structure as the ovary wall, but the white tips to the perianth segments are more leaf-like in structure since they contain a mesophyll.

The development of the archesporium in the anthers proceeds normally. The wall of a fertile anther is made up of an epidermis, an endothecium, a layer which subsequently disintegrates, and the tapetum. The cells of the tapetum are multi-nucleate and secretory in function. The archesporial cell of the anther divides mitotically several times before reduction division takes place in the pollen mother-cell. The behaviour of the nuclei and chromosomes was difficult to follow on account of their small size, but at diakinesis twelve pairs of chromosomes were observed. The column-shaped placenta, on which arise the united carpels, develops gradually at the centre of the growing point. The carpels are eventually connected to a column-shaped style terminating in a stigma which is at first globular, but later becomes strongly three-lobed and provided with papillæ. In the naked ovules an archesporium of several cells arises in the hypodermal layer and develops into the embryo-sac mother-cells without previously giving rise to any tapetal cells. Reduction division is usually completed only in one embryo-sac mother-cell. The embryo-sac, which eventually contains eight nuclei, develops as in *Lilium*. Details of the development of the embryo from the fertilized egg are given. The perianth turns inwards and the ovary swells considerably. Achenes are formed of which the hard outer coats enclose an endosperm, which contains oil and aleurone grains in addition to the embryo. Experiments concerning the germination of the seed are described. There is an account of the anatomy of the stem, leaf, root, and root-stock of the mature plant. C. R. M.

Macrosporogenesis and Embryology of Melilotus.—D. C. Cooper ("Macrosporogenesis and Embryology of *Melilotus*," *Bot. Gaz.*, 1933, **95**, 143–55, 2 pls.). The material used in this investigation was from *Melilotus alba* and *M. officinalis*, and the variety Redfield Yellow, which may be a hybrid between the two species. The archesporial cell, which divides to form a primary parietal and a primary sporogenous cell, arises in the hypoderm. In *M. officinalis* and Redfield Yellow the primary sporogenous cell functions as the macrospore mother-cell, but in *M. alba*, on the other hand, one to three sporogenous cells are formed of which only one develops further. The chalazal macrospore out of the four produced, alone develops into a seven-celled embryo-sac, whilst the remaining three macro-spores disintegrate. The embryo-sac becomes considerably elongated, the basal part becoming embedded in the nucellus, whilst the apical end lies in contact with the inner integument. The antipodal cells are decomposed immediately before fertilization. The pollen-tube enters the embryo-sac between the elongated synergids and the egg. The synergids persist for some time after fertilization has taken place. The zygote divides to form a filament of four cells, of which the terminal one forms the embryo. The basal ones, by repeated divisions, form a multicellular suspensor. The primary endosperm nucleus divides before the zygote, and the endosperm is entirely absorbed by the time the embryo is mature. The haploid number of chromosomes is eight. C. R. M.

Embryo-sac Development in Argemone mexicana Linn.—A. C. Joshi ("Megaspore Formation and Embryo-sac of *Argemone mexicana* Linn.," *J. Ind. Bot. Soc.*, 1933, **12**, 83–91, 1 fig., 1 pl.). In *Argemone mexicana* there is a single hypodermal archesporial cell which divides transversely to form the primary wall-cell and the megaspore mother-cell. The megaspore mother-cell does not by successive divisions give rise to a linear tetrad of megaspores as is usual in the majority of the flowering plants, but the four megaspores are arranged in a T-shaped tetrad. This arrangement has not hitherto been described in closely related genera of the Papaveraceæ, although it has been recorded in a wide range

of quite unrelated families. The antipodals are eight to ten times as large as the egg-cell in the mature embryo-sac, whilst the very small synergids degenerate at a very early stage without taking any part in fertilization. The endosperm develops quickly at a very early stage even before fertilization has taken place.

C. R. M.

CRYPTOGAMIA.

Pteridophyta.

Pilularia.—DUNCAN S. JOHNSON (" Structure and Development of *Pilularia minuta* Durieu," *Bot. Gaz.*, 1933, **95**, 104–27, 44 figs.). An account of the structure and development of the rare Mediterranean species, *Pilularia minuta.* It is the simplest of all the Marsiliaceæ and the most reduced member of that family. The vegetative organs are simplified, and the sporocarp has but two sori ; each sorus comprises a single megasporangium and two microsporangia ; further, the branches of the vascular bundle in the capsule are reduced, and their ventral tips lack the anastomoses which characterize *Marsilia* and all other known species of *Pilularia*.

A. G.

Equisetum.—ISABEL M. P. BROWNE (" A Fifth Contribution to our Knowledge of the Anatomy of the Cone and Fertile Stem of Equisetum," *Ann. Bot.*, 1933, **47**, 459–75, 8 figs.). A discussion of the anatomy of the stele of the cones of several species of *Equisetum*, illustrated by reconstruction figures and with a table of the anastomoses of the metaxylem and protoxylem systems of the cones of the nine species which have been investigated.   A. G.

Equisetum scirpoides.—MARION A. JOHNSON (" Origin and Development of Tissues in *Equisetum scirpoides*," *Bot. Gaz.*, 1933, **94**, 469–94, 1 pl., 29 figs.). An investigation of the anatomy of *Equisetum scirpoides*, the smallest member of the genus. The first periclinal division in each segment from the apical cell divides pith from " primary cortex " ; and these give rise respectively to stele and cortex. From the stele are formed pericycle, endodermis, and one or two layers of the inner cortex of the stem. The so-called inner endodermis of the root is to be regarded as pericycle. The endodermis and pericycle of the root are of cortical origin. Dormant branches occur as in other members of the genus, and are of exogenous origin. The first root developed by the branch is endogenous. The stelar parenchyma in the root is much reduced. Hydathodes of water stomata type occur on the upper surface of the leaves. Well-developed tyloses are found in the carinal canals but are rare. Xylem is extremely reduced, the supranodal wood being often absent above the leaf traces. Gaps in the xylem of the cone are correlated with the size of the stele and failure of the fundamental tissue to develop.   A. G.

Equisetum.—GIORGINA MARRO (" Il riconoscimento delle specie italiane del genere ' *Equisetum*,' fondato sui caratteri anatomici dell' apparato vegetativo," *Nuov. Giorn. Bot. Ital.*, 1933, **40**, 94–117, 22 figs.). A description of the distinctive vegetative characters of each of the eight Italian species of *Equisetum*, with figures of transverse sections, and a key for the easy determination of the species.

A. G.

Anomalies of Equisetum.—RINALDO CORRADI (" Anomalie dell' ' *Equisetum maximum* ' L.," *Nuov. Giorn. Bot. Ital.*, 1933, **40**, 127–32, 3 figs.). Description and figures of abnormal examples of *Equisetum maximum*—one a vegetative stem,

bearing four fertile spikes at the apex ; another bearing an apical spike and fifty little spikes each terminating a branchlet ; and three fertile stems bearing each a fasciated spike.   A. G.

Trichomanes.—E. B. COPELAND (" *Trichomanes*," *Philippine J. Sci.*, 1933, **51**, 119–280, 61 pls.). A monograph of *Trichomanes*, which has required many years to prepare owing to the careless work of predecessors. The genus is here divided into fifteen groups, with a key. Each group of species is preceded by a key, and under each species the original description is quoted and is followed by critical notes. Doubtful species are intercalated in what appear to be their proper places. In all, 112 species are accepted as valid ; some of them are new to science. *Cardiomanes* Presl is maintained as a separate genus..   A. G.

Aspidium in Japan.—TAKENOSHIN NAKAI (" Notes on Japanese Ferns. IX.," *Bot. Mag. Tokyo*, 1933, **47**, 151–86, 1 pl.). The first chapter of this paper contains a new classification of the Japanese species of *Aspidium*, in which special weight is given to the structure of the spores and to the nature of the connecting cells intercalated between the sporangium-sac and its stalk. These points are made clear by a series of figures. Six genera are defined—*Aspidium*, *Dictyocline*, *Dictyopteris*, *Dryomenis*, *Pleocnemia*, and *Sagenia*. The Japanese species are arranged under these genera, their synonyms and references are cited, and keys are supplied where necessary. The second chapter gives descriptions of new species of East Asiatic ferns and of three new genera—*Pneumatopteris* (for *Aspidium callosum* Blume), *Acystopteris* (for *Cystopteris japonica* Luerssen), *Spicantopsis* (for *Lomaria niponica* Kunze) ; also *Anapausia* Presl is retained for a section of *Gymnopteris.*   A. G.

Apogamy in Ferns.—W. N. STEIL (" New cases of Apogamy in certain Homosporous Leptosporangiate Ferns," *Bot. Gaz.*, 1933, **95**, 164–7, 6 figs.). Descriptions of apogamy in *Pteris flabellata*, *Pellæa cordata*, and *Cheilanthes Feei.*   A. G.

Bryophyta.

Burmese Anthoceros.—L. P. KHANNA (" A New *Anthoceros* from Burma," *J. Bot.*, 1933, **71**, 125–6, 6 figs.). A description and figures of *Anthoceros Parkinsonii*, a new species collected at Maymyo in the Northern Shan States, Burma. It is diœcious, produces yellow-brown spores, and has no mucilage chambers.
                                                                                          A. G.

Japanese Hepaticæ.—YOSHIWO HORIKAWA (" Studies on the Hepaticæ. VIII," *J. Sci. Hiroshima University*, 1933, Series B, div. 2, **1**, 197–205, 1 pl., 4 figs.). Descriptions and figures of nine species of Japanese Hepaticæ, eight of which are new to science.   A. G.

Water Conduction in Mosses.—ESTHER J. BOWEN (" The Mechanism of Water Conduction in the Musci considered in Relation to Habitat. II. Mosses growing in Damp Situations," *Ann. Bot.*, 1933, **47**, 635–61, 41 figs.). Nine mosses, which grow in damp, not wet, habitats, were studied : (1) As to their external morphology and their capacity to conduct water externally ; (2) as to the internal structure of their stems and leaves, and their capacity to imbibe liquid and conduct it internally. Except in the case of *Mnium punctatum*, the amount of water conducted externally exceeded that conducted internally ; it passed up in the form of capillary films between the leaves and the stem, and was absorbed by the

unthickened cells at the apex of the stem and in the leaves and branches, and diffused laterally and downward in the interior. On the other hand, the internal water current was found to travel up through the narrow, elongated, thin-walled cells of the central strand. It was also noted that the moister the habitat became, the less capable did the plant become to conduct water externally and internally, probably through having its needs made good by superficial deposition of moisture from the humid atmosphere. A. G.

New Zealand Mosses.—H. N. DIXON and G. O. K. SAINSBURY ("New and Rare Species of New Zealand Mosses," *J. Bot.*, 1933, **71**, 213–20, 244–51). Descriptions of twelve new species and two varieties, and notes on thirty-five other mosses. The whole forms a supplement to H. N. Dixon's "Studies in the Bryology of New Zealand" which was published in the *New Zealand Inst. Bull.*, no. 3 (1913–29). A. G.

<div align="center">Thallophyta.</div>

<div align="center">Algæ.</div>

Classification of Algæ.—JOSEPHINE E. TILDEN ("A Classification of the Algæ based on Evolutionary Development, with Special Reference to Pigmentation," *Bot. Gaz.*, 1933, **95**, 59–77, 1 pl.). A proposed scheme for the classification of existing groups of algæ based upon their geological ancestry and upon their inherent pigmentation. Thus marine Cyanophyceæ were the first to appear in the Archæozoic era, followed by Rhodophyceæ, and then Phæophyceæ. Then came the Chrysophyceæ (including the diatoms and other unicellular groups), and, as the Proterozoic era advanced, the marine Chlorophyceæ leading on to the freshwater Chlorophyceæ. Later on, in the Palæozoic era, arose the bryophyta, then the pteridophyta, then the gymnosperms, and last of all, in the Cenozoic, the angiosperms. The algæ are discussed group by group, and a coloured chart is given in which the geological age of each group is correlated with the nature of the distinctive pigments. A. G.

Thermal Algæ.—YOSHIKADSU EMOTO ("Die Mikroorganismen der Thermen. Eine historische Übersicht über die Erforschung der Thermalmikroorganismen," *Bot. Mag. Tokyo*, 1933, **47**, 268–95). A historical review of literature published on the investigation of the organisms of thermal springs during the past hundred years, with a bibliography of 188 works. A. G.

Oscillatoria in China.—CHU CHIA WANG ("Some Species of *Oscillatoria* of Nanking," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **8**, 244–52, 1 pl.). Descriptions and figures of thirteen species of *Oscillatoria* with a working key. They were collected at Nanking. A variety of *O. tenuis* grows with *Phormidium* on the sides of pools of hot water, with a temperature of 58° C., at Tang-shan. While the ponds in which the species of *Oscillatoria* occur are rendered unpleasant by the oil globules escaping from the decayed filaments, it was noted that the plants afford food to blood worms which in turn afford food for fishes and other animals. A. G.

Phormidium.—MARSHALL A. HOWE ("A Blue-Green Alga of Carbonated Mineral Water," *Bull. Torrey Bot. Club*, 1933, **60**, 465–8, 2 pls.). Description of a new blue-green alga, *Phormidium Demingii*, which forms calcareous crusts on stones moistened by the spray of the Polaris Spring, Saratoga Springs, New York. The water contains large quantities of calcium bicarbonate, sodium chloride,

sodium bicarbonate, magnesium bicarbonate, and at the time of its discharge is supersaturated with carbon-dioxide gas. The alga is of a blue-green or blue-purple colour; and is composed of short, erect, parallel filaments of minute sub-quadrate cells with mucilaginous walls. A. G.

Ecballocystis.—F. E. FRITSCH (" Contributions to our Knowledge of British Algæ. V. A British Species of *Ecballocystis* (*E. fluitans* sp. nov.)," *J. Bot.*, 1933, **71**, 187–96, 3 figs.). A detailed account of a new species of *Ecballocystis* collected in 1924 by the late C. Turner near Tal-y-bont in Merionethshire. It is hoped that the plant may be found again, and studied in the living state, to complete our knowledge of its life-history. A. G.

Coccomyxa on Starfish.—TH. MORTENSEN & L. KOLDERUP ROSENVINGE (" Sur une nouvelle algue, *Coccomyxa astericola*, parasite dans une astérie," *K. Danske Vidensk. Selsk. Biolog. Meddelelser*, 1933, **10**, no. 9, 1–8, 2 figs.). Descrip-tion of a new alga, *Coccomyxa astericola*, which forms green spots on a red starfish, *Hippasteria phrygiana*, dredged up in the Rognesund Strait, Norway. It is a small unicellular alga with a thin cellulose enclosing membrane ; and it is specifically distinct from the somewhat similar plant *C. Ophiuræ*. A. G.

Spirogyra in China.—CHU CHIA WANG (" Species of *Spirogyra* of Nanking," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **8**, 193–218, 8 pls.). A list of twenty-one species of *Spirogyra* with descriptions and figures and a key. They were gathered in some ten localities. Two species and two varieties are described as new to science. A. G.

Indian Caulerpæ.—S. C. DIXIT (" Caulerpaceæ from Malvan Harbour," *J. Univ. Bombay*, 1933, **1**, pt. v, 35–36, 4 pls.). Notes on seven species and some varieties of *Caulerpa* found in Malvan harbour on the west coast of South India, with photographs of eight of the plants. A. G.

Myriotrichia.—R. E. SCHUH (" *Myriotrichia densa* in New England," *Rhodora*, 1933, **35**, 256–7). Six species of *Myriotrichia* have been recorded for the coasts of North America and Europe, but the species are difficult to define ; and, despite the efforts of Kuckuck to differentiate between them in 1899, the present writer is dissatisfied with the results, and claims that it is a question of one polymorphic species which assumes very different aspects in the course of its development. However, if *M. densa* Batt. is a valid species, he wishes to record its occurrence on the coast of Maine—not on *Zostera*, but on *Asperococcus* and *Scytosiphon*. A. G.

Pterygophora.—HAZEL HAYDEN MCKAY (" The Life-History of *Pterygophora californica* Ruprecht," *Univ. Calif. Pub. Bot.*, 1933, **17**, 111–48, 7 pls.). An account of the life-history of *Pterygophora*, based on morphological and cytological data, giving special attention to the development of the male gametes and the process of fertilization. The ordinary plant (sporophyte) of *P. californica* is diploid, with chromosomes twenty-six in number. No spireme is evident in somatic mitosis, the chromosomes being formed by the fusion of chromatin granules aggregated at the junction of the reticular fibrils. They are very small, but in the metaphase plate three pairs of short rods, one pair of very small spheres, and nine pairs of ovoid chromosomes can be seen. The reduction in chromosome number occurs in the first division of the zoosporangium nucleus, when a distinct spireme, synizetic knot, and a typical diakinesis configuration are evident. The haploid zoospores

germinate in haploid gametophytes. The male and female gametophytes in the early stages are distinguished only by a marked difference in the diameter of the filaments. They mature in seven weeks, and flourish and fruit for several months. One large non-motile egg is borne in each oogonium ; and similarly one minute motile antherozoid is produced in each antheridium. The male gamete is pyriform and laterally biciliate, and contains a nucleus, an eyespot, and a remnant of a chromatophore. After the egg is discharged from the oogonium fertilization soon follows, and a wall is formed round the egg. The male and female nuclei fuse when in the early prophase of division. The twenty-six chromosomes become evident at metaphase in the fusion nucleus, which then passes through typical anaphase and telophase stages as the egg elongates, and finally a transverse wall is formed between the two daughter nuclei. The diploid number of chromosomes is evident in the young sporophyte.　　　　　　　　　　　　　　　　　　　　　　　A. G.

Algal Immigrants.—D. E. HYLMO ("Algenimmigration nach der schwedischen Westküste," *Bot. Notiser*, 1933, 377–90, 4 figs.). *Fucus inflatus* is a northern species recently immigrant on the west coast of Sweden, but is confined to the vicinity of harbours. The author discusses its distribution and probable origin. Its receptacles contain both oogonia and antheridia, and thus the plant can be distinguished from evesiculose forms of *F. vesiculosa*, which is dioicous ; further, *F. inflatus* possesses little or no midrib, and its receptacles are elongate and cylindric. *Callithamnion roseum* is another recent arrival on the west coast of Sweden.
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　A. G.

Algerian Algæ.—JEAN FELDMAN " Contribution à la Flore algologique marine de l'Algérie. Les Algues de Cherchell," *Bull. Soc. Hist. Nat. de l'Afrique du Nord*, 1931, **22**, 179–254, 6 pls, 8 figs.). An account of 218 algæ collected and studied at Cherchell during a sojourn of nearly a year, with a description of the habitats investigated. Some forty-seven species and four varieties are added to the Algerian flora.　　　　　　　　　　　　　　　　　　　　　　A. G.

Fungi.

Lagena.—J. H. L. TRUSCOTT (" Observations on *Lagena radicicola*," *Mycologia*, 1933, **25**, 263–6, 11 figs.). This fungus, first discovered in Saskatchewan, is now reported from Ontario and in this form the sporangia are typically branched. This with other differences suggests that this may be another species. F. L. S.

New Olpidiopsis.—S. J. DU PLESSIS (" The Life-History and Morphology of *Olpidiopsis Ricciæ* nov. sp., infecting *Riccia* species in South Africa," *Ann. Bot.*, 1933, **47**, 755–62, 12 figs.). The fungus was found in the rhizoids of three species of *Riccia* from Stellenbosch and Knysna. The zoosporangia open either by fissures or by unbranched exit tubes depending upon moisture conditions and liberate biciliate zoospores which infect very young rhizoids. There is some evidence that fertilization of the oogonia precedes the formation of the light-brown warted oospores.　　　　　　　　　　　　　　　　　　　　　　　　F. L. S.

Saprolegniaceæ.—J. CHAZE ("Les Saprolégniacées : leur importance dans les études cytologiques et physiologiques depuis 1924. Nouvelle technique de culture pure de ces champignons," *Bull. Soc. Bot. Fr.*, 1933, **80**, 323–7). A résumé of work done by a number of botanists on the cytology of a member of the genus *Saprolegnia* grown in pure culture by the author and an account of his method of

obtaining the fungus from diseased fish. The fish, living or recently dead, is kept in running water until there is a good growth of hyphæ. These are removed, washed in distilled water containing lactic acid, and cultured on *Soja hispida* agar.

F. L. S.

Entomophthora.—W. H. SAWYER ("The Development of *Entomophthora sphærosperma* upon *Rhopobota vacciniana*," *Ann. Bot.*, 1933, **47**, 799–809, 2 pls., 25 figs.). The investigation mainly concerns the relation between the parasite and its newly recorded host. Infection occurs through the body wall, never by the digestive tract; different structures of the larva are destroyed in turn until, finally, nothing but the chitinous coat remains. At this point, when food-material for the fungus is no longer available, resting spores and conidia are produced.

F. L. S.

Neutral Mucor.—M. MOORE ("A Neutral (?) Strain of *Mucor sphærosporus* from Missouri," *Ann. Miss. Bot. Gard.*, 1933, **20**, 469–70). The fungus was tested with plus and minus stains. No zygospores were formed. An attempt at imperfect hybridization gave no sexual reaction.

F. L. S.

Cerebrospinal Endomyces.—M. MOORE ("A Study of *Endomyces capsulatus* Rewbridge, Dodge & Ayers: A Causative Agent of Fatal Cerebrospinal Meningitis," *Ann. Miss. Bot. Gard.*, 1933, **20**, 471–553, 8 pls., 166 figs.). The organism is shown to have two life-cycles: one in the host as a budding cell and the other as an Ascomycete reproducing by eight-spored asci formed isogamously, heterogamously, or parthenogamously. The account includes cultural and physiological work and detailed descriptions and drawings of the organism on different media.

F. L. S.

Chætomium saltation.—H. DICKSON ("Saltation induced by X-rays in seven Species of *Chætomium*," *Ann. Bot.*, 1933, **47**, 735–54, 2 pls., 10 figs.). When hyphal tips were irradiated and cultured four of the species rarely saltated while the remaining three produced saltants very readily. The author gives an account of the chief differences in colour, hairs, and in the size and number of perithecia between the parents and saltants, together with figures of the saltant perithecia and photographs of the colour changes.

F. L. S.

Epichloe.—K. SAMPSON ("The Systemic Infection of Grasses by *Epichloe Typhina* (Pers.) Tul.," *Trans. Br. Myc. Soc.*, 1933, **18**, 30–48, 3 pls., 22 figs.). The fungus is an intercellular parasite which invades all the vegetative organs of grasses and overwinters in the perennial parts. The external parts and fruits of the fungus occur only on the fertile shoots of the host. "Latent infection," where there is no external sign of the fungus, occurs in *Festuca rubra* and may persist for several seasons. Apparently healthy panicles on infected plants were found to contain the fungus in the seeds between the pericarp and the endosperm.

F. L. S.

Tryblidiella.—C. L. SHEAR ("Life Histories of *Tryblidiella* Species," *Mycologia*, 1933, **25**, 274–86, 5 text-figs.). Single ascospore cultures from different species of *Triblidiella* produced diplodia-like macropycnidia and micropycnidia with hyaline spores, and cultures of apparently the same species but taken from different hosts showed a different kind of diplodia-like pycnidia. The diplodia forms resemble those from *Physalospora* so no dependence can be placed on imperfect stages in defining genera and species of Ascomycetes.

F. L. S.

New Sclerotinias.—R. W. DAVIDSON and E. K. CASH (" Species of *Sclerotinia* from Grand Mesa National Forest, Colorado," *Mycologia*, 1933, **25**, 266–74, 3 pls., 12 figs.). Of the eight species described five are new to science. Most of them were found at an elevation of 10,000 feet. A few observations are made on their conidial stages.   F. L. S.

Helotium.—B. BARNES (" *Helotium ciliatosporum* Boudier," *Trans. Br. Myc. Soc.*, 1933, **18**, 76–88, 5 figs.). A morphological and biological account of this Discomycete which was very abundant in a London garden and occurred on stems of a variety of hosts. It is suggested that the mycelium perennates in the substratum and that an accumulation of staling products brings about the marked periodicity in fruiting.   F. L. S.

Spore Discharge.—C. T. INGOLD (" Spore Discharge in the Ascomycetes. I. Pyrenomycetes," *New Phyt.*, 1933, **32**, 175–97, 10 text-figs.). Four types of spore-discharge have been observed, three being explosive and one exemplified by *Chaetomium* being non-explosive. A good deal of information is given also on distance, periodicity, and rate of discharge.   F. L. S.

New Smuts.—R. CIFERRI (" Ustilaginales esotici nuovi o rari. I," *Nuov. Giorn. Bot. Ital.*, 1933, **40**, 252–69, 1 fig.). Several new species and varieties are described and one new genus, *Liroa*, based on *Ustilago emodensis* Berk. occurring on *Polygonum chinense* from Java. A key to the species of *Farysia* is included.
                                                                        F. L. S.

New Rusts.—J. C. ARTHUR (" New Genera and Species of Uredinales," *Bull. Torrey Bot. Club*, 1933, **60**, 475–7). The genus *Cumminsiella* is made for those species having subepidermal pycnia and cupulata, æcidioid æcia, and which previously were included in *Uropyxis*. There are three North American species, all occurring on *Mahonia*, of which *C. sanguinea* (Peck) Arth. represents the type. *Uræcium* is a new form genus for species having pycnia and uredinoid æcia. New species in *Uredo* and *Æcidium* are described.   F. L. S.

North American Hypholomas.—C. S. PARKER (" A Taxonomic Study of the Genus *Hypholoma* in North America," *Mycologia*, 1933, **25**, 160–213, 6 pls., 38 figs.). This monograph includes an account of the history, phylogeny, taxonomy, and bibliography of the genus as well as a key to the species and full diagnoses. Six new species are described. Structural details are illustrated by microphotographs and drawings.   F. L. S.

Poria.—L. LING (" Studies of the Genus *Poria* of China," *Contrib. Biolog. Lab. Sci. Soc. China*, I, 1933, **8**, 222–33, 1 pl., 4 figs.). An account of eleven species, three of which are described as new. Sterile bodies such as setæ and cystidia are regarded as having greater taxonomic importance than the spores.   F. L. S.

Hydnaceæ.—L. W. MILLER (" The Genera of Hydnaceæ," *Mycologia*, 1933, **25**, 286–303). The author restricts the family to those members only in which the hymenium is borne upon downward directed spines, teeth, or warts, which have not arisen by the breaking up of pores. A key to the genera is given. Each genus is diagnosed with notes on synonyms and structure. The genus *Oxydontia* is made to include members having no cystidia and long, subulate, and conspicuous teeth.   F. L. S.

Grandinia and Oxydontia.—L. W. MILLER ("The Hydnaceæ of Iowa. I. The Genera *Grandinia* and *Oxydontia*," *Mycologia* 1933, **25**, 356–69). An account with keys and drawings showing structural details of six species of *Grandinia* and six of *Oxydontia*. F. L. S.

Sphærotilus Cultures.—E. NAUMANN ("Über die rohkultur von *Sphærotilus natans* Kützing in Büschelform," *Svensk Bot. Tids.*, 1933, **27**, 293–301, 4 figs.). The culture of this sewage fungus in its typical bushy growth form was readily carried out in thoroughly aerated moving water with an initial pH value greater than seven. F. L. S.

New Penicillia.—G. SMITH ("Some New Species of *Penicillium*," *Trans. Br. Myc. Soc.*, 1933, **18**, 88–92, 2 pls., 8 figs.). Three species were isolated from manufactured cotton goods and the fourth from Italian maize. Cultural as well as structural characteristics are recorded. One of the species, *P. pallidum*, is regarded as the type of a new section of the genus on account of the existence of foot-cells. F. L. S.

New Helicosporeæ.—D. H. LINDER ("North American Hyphomycetes. I. Two New Helicosporeæ and the New Genera *Haplochalara* and *Paspalomyces*," *Mycologia*, 1933, **25**, 342–9, 1 pl., 11 figs.). *Haplochalara* has conidia at first internal and hyaline, and later external, fuscous, and catenulate. An *Acrotheca*-like form found in association is regarded as a possible exogenous phase. *Paspalomyces* belongs to the Phæodidymeæ. F. L. S.

Nematode Parasite.—C. D. SHERBAKOFF ("A New Fungus Parasitic on Nematodes," *Mycologia*, 1933, **25**, 258–63, 1 pl., 12 figs.). This fungus, which was found on larvæ of minute flies and on nematodes in association with strawberry plants, has septate hyphæ and conidia which are terminal, septate, and in the shape of rings. F. L. S.

New Phomopsis.—G. G. HAHN ("An Undescribed *Phomopsis* from Douglas Fir on the Pacific Coast," *Mycologia*, 1933, **25**, 369–76, 1 pl., 5 figs.). *P. Lokoyæ*, which forms a canker on young Douglas Fir, is described as new to science. It is distinguished from *P. Pseudotsugæ* by its formation of pseudo-partitions in the fruits and its possession of B- as well as A-spores. F. L. S.

Disease of Freesias.—J. J. TAUBENHAUS and W. N. EZEKIEL ("Fusarium Wilt and Corn Rot of Freesias," *Bot. Gaz.*, 1933, **95**, 128–43, 25 figs.). The disease, which attacks and finally kills the whole plant, producing yellowing and collapse of the leaves and rotting of the corm and roots, is very destructive in Texas. Four species of *Fusarium*, two of which attack onions, were isolated and reproduced the disease on inoculation. Two more species from cabbage and tomato also produced typical symptoms, while five other species from various sources caused somewhat less severe injury. The disease is spread by infected corms, decayed plants, and by soil. F. L. S.

Mushroom Disease.—W. M. WARE ("A Disease of Cultivated Mushrooms caused by *Verticillium Malthousei* sp. nov.," *Ann. Bot.*, 1933, **47**, 763–85, 2 pls., 6 figs.). A structural account of a fungus which causes deformity of the entire mushroom if it becomes infected in an early stage of growth, whereas greyish-white spots on the undeformed caps and white areas on the stipe and gills are the result of later local infection. This *Verticillium* is regarded as identical with one incompletely described by G. T. Malthouse in 1901. F. L. S.

Roumanian Micro-fungi.—T. Săvulescu and C. Sandu-Ville ("Beiträge zur Kenntnis der micromyceten Rumäniens," *Hedwigia*, 1933, **73**, 71–133). Two hundred species, including two new Ascomycetes and twenty-two Fungi-Imperfecti, are listed, together with important literature, synonyms, diagnoses, measurements, and notes on every species.   F. L. S.

Nanking Fungi.—S. C. Teng ("Fungi of Nanking. V," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **8**, 253–71, 1 fig.). A list, with notes, of twenty Ascomycetes, ten Basidiomycetes, and forty-one Fungi Imperfecti which includes an account of three new species and a new variety in the genera *Massaria, Leptothyrium, Didymosporium*, and *Pseudolachnea* respectively.   F. L. S.

Chekiang Fungi.—S. C. Teng and L. Ling ("Fungi of Chekiang. III," *Contrib. Biolog. Lab. Sci. Soc. China*, 1933, **8**, 271–9, 1 fig.). Notes on thirty-three fungi with diagnoses of two new species, *Aleurodiscus sinensis* and *Pseudolachnea scolecospora*.   F. L. S.

Illinois Parasites.—L. R. Tehon ("Notes on the Parasitic Fungi of Illinois," *Mycologia*, 1933, **25**, 237–58, 1 pl., 27 figs.). Of the twenty-five fungi described seventeen are new to science and three are type species of new genera belonging to Leptostromataceæ and Excipulaceæ.   F. L. S.

Blastomycosis.—A. Castellani ("Blastomycosis: A Short General Account," Reprinted from *The Medical Press and Circular*, 1933, 9 figs.). This skin disease, common in North and South America and in the tropics, is caused by a large number of Fungi Imperfecti, fourteen of which are described morphologically and physiologically and are illustrated by microphotographs.   F. L. S.

Precipitin-ring Test.—G. K. K. Link and H. W. Wilcox ("Precipitin-ring Test applied to Fungi. II," *Bot. Gaz.*, 1933, **95**, 1–35). Potent antisera and test antigens were prepared from thirty-four species and strains of fungi by using fractions soluble in 0·85 p.c. sodium chloride. Only in some cases was there sufficient specificity to permit differentiation. In a few cases absorption of precipitin differentiated fungi not separable by the precipitin test.   F. L. S.

Lichens.

Lichens of Costa Rica. I.—Carroll W. Dodge ("The Foliose and Fruticose Lichens of Costa Rica," *Ann. Miss. Bot. Gard.*, 1933, **20**, 373–467). At the outset of his paper Dodge gives an account of his study of the subject in European herbaria followed by a full description of Costa Rica. The land touches both Atlantic and Pacific and is varied by hill and valley with coastal lagoons; forests are still to be found, the trees covered with various lichens. Volcanic soil is a prominent feature of the valleys; in Liberia there occurs a soft pumice laid down in water. An account follows of botanical and chiefly lichenological exploration and a general survey of lichens and their distribution. Dodge found that affinities of the flora were mainly with Brazil (eastern). Few species are common to Mexico or Peru and Costa Rica. A key is provided to tropical American families of foliose and fruticose lichens, and a studied account of the various families follows, each genus with its separate key. A subgenus, *Dicollema*, based on *Collema pycnocarpum* and a genus *Malmella* near to *Erioderma* and *Pannaria* are described, the latter with several new species. All the genera and species are described at length in Latin and English.   A. L. S.

Lichens of Tierra del Fuego.—Veli Rasanen ("Zur Kenntnis der Flechtenflora Feuerlands, sowie der Prov. de Magallanes, Prov. de Chiloë und Prov. de Ñuble u Chile," *Ann. Bot. Soc. Zool. Bot. Fenn.*, 1932, **2**, I–VI, 1–65, 2 pls., 1 map). The lichens were collected by H. Roivainen during the Finnish Expedition to Tierra del Fuego and determined by V. Rasanen. A comparison is drawn between Arctic and Antarctic lichens, which have much in common, and a list is given of thirty-four common to these two regions. These widely separated species show many differences giving rise to varieties and forms. Some new species and varieties are included, but the great majority have been already described. A useful list of literature dealing with the area is given.   A. L. S.

Japanese Lobariæ.—Y. Asahina ("*Lobaria*-arten aus Japan. I," *J. Jap. Bot.*, 1933, **9**, 333–9, 12 text-figs., Japanese). A full description of species already determined. The species are well illustrated.   A. L. S.

Lichens of Morocco.—R. G. Werner ("Contribution à la flore crypto-gamique du Maroc," *Cavanillesia*, 1932, **5**, 157–73, 2 pls.). Werner gives a descriptive account of the territory explored in the north-west of Morocco, both on the sea coast and on the inland regions, and including calcareous as well as siliceous areas; the sea coast also furnished maritime species. Werner enumerates fifty-seven species, of which ten are new to science and others new to Morocco or to Africa. Several of the species are described under new or redescribed genera, such as *Aspiciella* with ovoid spores and *Chrysomma*, distinguished by a well-developed " proper " margin of the apothecium, within the thalline margin. He retains the genus *Caloplaca* for those with the thalline margin only.   A. L. S.

Notes on Japanese Lichens.—M. M. Satô ("Notes on some Japanese Lichens determined by Dr. Edw. A. Wainio," *J. Jap. Bot.*, I, 1933, **9**, 67–74, 7 text-figs.). The species were determined by Wainio. The descriptions are in Japanese, the names are in Roman characters, and the figures are illuminating.   II. A further series of the Wainio determinations (*Tom. cit.*, 142–4, 4 text-figs.). The species described are *Pertusariæ* and new to science.   A. L. S.

Notes on Japanese Lichens. V.—M. M. Satô (*Tom. cit.*, 339–43, 3 text-figs.). In this contribution Satô continues his account of Lichens determined by Waino belonging to the genus *Parmelia ;* they are mostly illustrated. A. L. S.

Lichen from Formosa.—A. Zahlbruckner (" Flechten der Insel Formosa," *Repert. Spec. Nov. Regn. Veget.*, 1933, **33**, 22–68). A considerable number of lichens are recorded for the island, many of them new species belonging to many different genera.   A. L. S.

Lichen Flora of Bonin Islands.—M. M. Satô (" Materials for a Lichen flora of Bonin Islands. II," *J. Jap. Bot.*, 1933, **8**, 470–5, 2 figs.). Satô deals with several species of Collemaceæ of wide distribution; an English résumé gives locality and habitat. The lichens are all well-known species.   A. L. S.

Lichens from Labrador.—J. Podpera and J. Suza (" Ad Bryophytorum et Lichenum cognitionem Peninsulæ Labrador Additamentum," *The Bryologist*, 1932, **35**, 54–6). Habitat and locality of the lichens are given. They were determined by the authors from a collection made by Dr. V. Suk mostly in the littoral tundra region of Labrador near Makkovik, Nain, and Hebron.   A. L. S.

Cladoniæ from Maine.—HELEN PITMAN (*The Bryologist*, 1933, **35**, 72–3). A short account of *Cladoniæ*, their appearance and habitat, and a list of the species collected.   .   A. L. S.

American Lichens.—CHARLES C. PLITT ("Two New Species of Lichens," *The Bryologist*, 1933, **35**, 82–3). The new species, *Cyphelium subtigillare* and *Lecanora lividolutea*, were determined by Räsänen. They were in a collection sent to Räsänen by C. Plitt.   A. L. S.

Japanese Lichens.—YASUHIKO ASAHINA ("Notes on Japanese Lichens. VII," *J. Jap. Bot.*, 1933, **8**, 37–9, 6 text-figs.; "Lichenologische Notizen," *Op cit.*, 1933, **9**, 64–7, 3 text-figs.). In these two contributions Asahina continues his examination and description of Japanese lichens, most of them new species; all of them are more or less crustaceous forms

("Lichenologische Notizen," *Tom. cit.*, 138–41, 4 text-figs.) Asahina describes four species of *Perforaria*. He notes that alkaline reactions and the presence of cephalodia are very variable and cannot be used as specific characters in the genus.   A. L. S.

Lichens from Bonin.—M. M. SATÔ ("Materials for a lichen flora of Bonin Islands. I," *J. Jap. Bot.*, 1933, **8**, 388–90, 3 text-figs.). As a first contribution, Satô describes two species of *Cænogonium*. He gives two sections of the genus: I *Holocænis*, II *Cænobiatorina*. The species described (one new to science) belong to *Holocænis*. The descriptions are in Japanese.   A. L. S.

Lichens of Montenegro.—DR. FRAN KUSAN ("Flora i vegetacija lisaja jeverozapadnik crugorskik, planina," *Jugoslav. Akad. Znanosti i Umjetnosti u Zagrebu*, 1933, **18**, 68–124, 1 fig., 2 pls.). This paper in the Jugoslav language is mainly occupied by a list of lichens found in the Montenegrin district examined by the writer. There is further a lengthy discussion of the ecological associations with lists of the lichens in each group. A new species, *Ramalina Voukii*, described by Zahlbruckner is included.   A. L. S.

New or Rare Lichens.—KARL REDINGER ("Neue und wenig bekannte Flechten aus Brasilien," *Hedwigia*, 1933, **73**, 54–67, 8 text-figs.). A series of fifteen crustaceous species mostly on the bark of trees and belonging to several genera—*Porina, Chiodecton*, etc.; they are well illustrated.   A. L. S.

Lichens from the East.—KARL REDINGER ("Graphidineen von Celebes und Java," *Ann. Mycol.*, 1933, **31**, 168–80, 1 pl., 1 text-fig.). The author has given descriptions and figures of fourteen species, several of them new to science. He notes the affinity of the species generally with those recorded by Wainio from the Philippines.   A. L. S.

Cephalodia on Opegrapha.—KARL REDINGER ("Epigene Cephalodien auf Opegrapha," *Arch. fur Mikrobiologie*, 1933, **4**, 237–40, 5 text-figs.). The Cephalodia were found on *Opegrapha robusta* in various stages of development. The alga, a member of the Cyanophyceæ, was determined as probably *Chroococcus* or possibly *Aphanocapsa*. The form and development are described.   A. L. S.

Italian Lichens.—M. CENGIA-SAMBO ("Fragmenta Lichenologica. II. Una nuova Sezione del gen. *Caloplaca* Th. Fr. ed ætre entita nuove," *Nuove Giorn. Bot. Ital.*, 1933, **40**, 281–7, 1 fig.). Cengia-Sambo describes *Caloplaca Chanousiæ*

n.sp. which differs from other species of the genus in that the spores are uniseptate but not polarilocular. For this reason she places it in a new section, *Candelariopsis.* In some particulars it approaches the genus *Candelaria* though, unmistakably, it is more allied to *Caloplaca.* It was collected on schists at Chanousia. A list of other lichens collected at Chanousia, fifty-three in all, is appended. A. L. S.

Lichen from the Catskills.—RAYMOND H. TORREY (" *Parmelia Cladonia,* a beautiful Northern Lichen, found on Catskill Summits," *Torreya,* 1933, **33,** 87–9). The lichen when first collected was referred to *Evernia furfuracea* var. *Cladonia* by Tuckerman. It is a northern species, with narrow fronds densely entangled, " glabrous gray above, and more or less solid black on the channelled under side." It grows on living firs, also on dying or dead trees. A. L. S.

Study of Symbiosis.—EDGAR KNAPP (" Ueber *Geosiphon pyriforme* Fr. Wettst., eine intrazelluläre Pilz-Algen-Symbiose," *Ber. Deutsch. Bot. Gesellsch.,* 1933, **51,** 210–16, 1 pl.). The author found that the vesicles of the alga *Geosiphon* were occupied by *Nostoc* chains and also by colourless hyphæ. It was proved by cultural methods that the *Nostoc* was taken up from the soil and that the species was confined to *Geosiphon* vesicles, though it has not yet been proved if there are more than one *Nostoc* species involved. When a *Geosiphon* vesicle is placed on agar colourless hyphæ are produced from the base. When a *Nostoc* is added, vesicles are formed at the point of encounter. At this position rich protoplasm is developed in the hyphæ which is then seen to become detached and to surround the *Nostoc* chains. The protoplasm acquires a membrane and takes up *Nostoc* cells. A vesicle is formed thus containing the *Nostoc* cells. It has not yet been possible to induce the formation of *Geosiphon* vesicles by associating isolated *Nostoc* with isolated mycelium. A. L. S.

American Lichens.—J. P. B. RÄSÄNEN (" Contribution to the Lichen Flora of North America," *Ann. Miss. Bot. Gard.,* 1933, **20,** 7–20). The lichens enumerated were collected in the northern section of North America—Alaska, New Brunswick, and Western Canada ; most of them collected by Dr. Viljo Kugala. The number recorded in the paper—species, varieties, and forms—reaches a total of 171 ; five species are new to science. The lichens are chiefly epiphytic and soil lichens, they are compared with the same species from Russia and Asia. A great many are common to North America and Eurasia. A. L. S.

Lichen Systematy and Animal Feeding.—ALWIN SCHADE (" Flechten-systematik und Tierfraz," *Ber. Deutsch. Bot. Gesellsch.,* 1933, **51,** 168–92). The author has made a study of the small insects, snails, etc., that feed on lichens and the effect of their depredations on the lichen plants. He enumerates the plants examined, with reference to their situation and illumination. He describes the traces of their presence left by the animals, and the portions of the lichens pre-ferred. They destroy the cortex and gonidial layer and penetrate deeply into the medulla of the thallus. Their presence can be traced by the white spots and lines visible on the thallus. Snails are the most voracious feeders and leave long white lines where they have fed. Notes are given as to the influence of animal depredation on the form and growth of the lichen, and Schade has referred to a number of species and varieties that, owing to changes so produced, have been described as new species or varieties. It has been noted also that fungal parasites grow readily on the denuded thalli. Schade finds no evidence that lichen acids protect the plants from the attacks of animals. A. L. S.

Lichen of Iron Rocks.—A. SCHADE ("Das Acarosporetum sinopicæ als Charakter merkmal der Flechtenflora sachsischer Bergwerkshalden," *Sitzungsb. und Abhandl. Naturwissensch. Gesell. Isis in Dresden*, 1933, 131–60). Schade gives in this paper an account of the lichen vegetation on the rocky slopes of the hills of Saxony near to Freiburg, Marienburg, and other towns. They are grouped under an *Acarosporetum sinopicæ*, as *Acarospora sinopica* is the dominant species. These rocks are largely impregnated with iron, and the iron coloration of the lichen thallus is therefore a dominant feature. Iron has been found in some of the red-coloured lichens over the white surface, as also in the hypothallus; in others, such as *Lecidea Dicksonii*, it is confined to the hypothallus or the medulla. These lichens avoid generally the larger slopes and sunnier exposures, their place being taken by *Buellia sororia* and *Lecidea fumosa*. It has also been observed that *Acarospora sinopica* and *Lecidia silacea* are unharmed by snails, while *Rhizocarpon Œderi* and especially *Lecidia Dicksonii* show constant traces of nibbling.

A. L. S.

Mycetozoa.

Japanese Mycetozoa.—G. LISTER ("New Varieties of Mycetozoa from Japan," *J. Bot.*, 1933, **71**, 220–22). The species examined were collected by the Emperor at Nasu in the Tochigi prefecture. They proved to be new varieties of well-known species—*Didymium leoninum* var. nov. *effusum* and *Arcyria pomiformis* var. nov. *heterspora*. The varieties are fully described.

A. L. S.

Australian Mycetozoa.—G. LISTER ("A New Species of *Dictydium* from Australia," *Tom. cit.*, 222–23). Nineteen species were sent for identification; one of them proved to be new to science and was named *Dictydium rutilum*—the spores red, inclining to gold or carrot coloured. A. L. S.

Japanese Mycetozoa.—HIROTARÔ HATTORI ("Figures and Brief Descriptions of the Nipponese Mycetozoa, VIII," *J. Jap. Bot.*, 1933, 438–46, 13 text-figs.). Descriptions and interesting illustrations of a series of Mycetozoa of the genus *Physarum*, *Lamproderma*, *Dictydiœthalium* and *Perichœna*. A. L. S.

Study of Mycetozoa.—YOSHIKADZU EMOTO ("Studien über die Myxomyceten in Japan," *Bot. Mag. Tokio*, 1933, 47, 371–83). Emoto has given an outline of the study of Mycetozoa since the earliest discovery of *Physarum* sp. by N. Tanaka in 1888. Up to the present, there have been listed over 300 species belonging to about fifty-five genera. The chief workers in this group of organisms have been duly recognized and their special studies outlined. A list of the various works referring to Japan comprising seventy-four publications completes the paper. A. L. S.

TECHNICAL MICROSCOPY

Mr. Waldron Griffiths, F.R.M.S., sends the following account of an apparatus for the automatic washing of material fixed by the chromic acid series of fixatives.

The apparatus acts as an intermittent syphon, the water being constantly changed.

It consists of a wide-mouthed bottle (a 1 oz. quinine bottle will do very well) fitted with a good cork pierced with three holes to take tubes. One tube of about ⅜-inch bore should be straight, flayed at one end, and over this is fitted a piece of fine-mesh bolting silk, secured by string, or a small rubber band, if xylol is not to be used.

The second tube is of smaller bore, about ⅛ inch, and is bent to form a syphon.
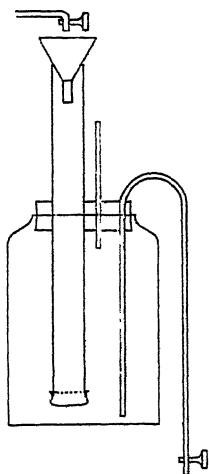
Of course, it is necessary that the exit end of the syphon should extend some distance below the bottom of the bottle. The third is a small tube to allow air to escape.

The material to be washed is then placed in the large tube and a gentle stream of water turned on it. When the bottle is full the contents are discharged into any receptacle, it is again filled up and the process is automatically repeated as often as necessary.

By this means an intermittent stream of water is kept up, and the fixing solution thoroughly washed away from the material in much less time than is necessary under the old method. There is also the advantage that the loss frequently occurring by washing under a stream of water in an open vessel is obviated.

If there is a tap at the end of the exit tube the rate and force of the stream can be regulated.

When the washing is complete the tube with its contents can be dismounted and subsequent operations such as staining, etc., can be carried on without disturbance.

The author has found this system of washing very useful in mounting algæ by the Venice turpentine method.

NOTICES OF NEW BOOKS

Elements of Optical Mineralogy. An Introduction to Microscopic Petrography. Part 2. Descriptions of Minerals.—By ALEXANDER N. WINCHELL. 3rd edition, 1933. xviii + 459 pp., 362 figs. Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 37s. 6d. net.

Zeiss Nachrichten.—Edited by Prof. Dr. F. HAUSER. Part 4. July, 1933. 40 pp., 25 figs. Published by Carl Zeiss, Jena, Germany.

The Fresh-water Algæ of the United States.—By GILBERT M. SMITH. 1933. 716 pp., 449 figs. Published by McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 36s. net.

Elements of Botany.—By RICHARD M. HOLMAN and WILFRED W. ROBBINS. 2nd edition. 1933. 404 pp., 268 figs. Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 16s. 6d. net.

British Fresh Water Copepoda.—By ROBERT GURNEY. 1933. Vol. 3. xxix + 384 pp., 866 text-figs. Published by the Ray Society. Obtainable from Dulau & Co., 32, Old Bond Street, London, W.1. Price 37s. 6d.

Watson's Microscope Record. No. 30.—September, 1933. 23 pp., illustrated. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

Index Animalium.—By C. D. SHERBORN. Part XXXII. Index to Trivialia under Genera, pp. 655–878. April, 1933. Part XXXIII. Index to Trivialia under Genera, pp. 879–1098. July, 1933. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 10s. each part.

The History of Staining.—By H. J. CONN and others. 141 pp., 9 pl. Published by the Biological Stain Commission, Geneva, N.Y. Price $2.

Fluorescence Analysis in Ultra-Violet Light.—By J. A. RADLEY and JULIUS GRANT. 1933. Vol. VII. xi + 219 pp., 18 text-figs., 1 + 10 plates. Published by Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 15s. net.

Modern Textile Microscopy.—By J. M. PRESTON, with foreword by F. SCHOLEFIELD. 1933. xi + 315 pp., 134 text-figs. Published by Emmott & Co., Ltd., 28, Bedford Street, London, W.C.2., and at 31, King Street West, Manchester, 3. Price 15s. net.

Medical Research Council: Special Report Series. No. 184. **The Eradication of Bovine Tuberculosis.**—By L. JORDAN. 104 + ix pp. Price 2s. net. No. 185. **Colour Vision Requirements in the Navy.** 58 + ix pp. Price 1s. net. No. 186. **Medical Uses of Radium.** 36 + ix pp. Price 1s. net. No. 187. **The Chemistry of Flesh Foods and Their Losses on Cooking.** 146 + x pp. By R. A. McCANCE and H. L. SHIPP. Price 2s. 6d. net. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

Fishery Investigations. Series II. Vol. XIII, No. 2. **The Natural History of the Hake.** Part IV. **Age Determination and the Growth-Rate.** By C. F. HICKLING. 1933. 120 pp., 41 text-figs., xvi tables. Price 5s. 6d. net. Series II. Vol. XIII, No. 3. **Variations in North Sea Plankton, 1923–1924.** By R. S. WIMPENNY. 1933. 47 pp., 10 text-figs., vi tables. Price 2s. 6d. net. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

An Index to the Genera and Species of the Diatomaceæ and their Synonyms. **1816–1932. Part V. Bi–Ch.** October, 1933. 76 pp. **Part VI. Ch–Co.** November, 1933. 74 pp. Published by F. W. MILLS, Milton Damerel, North Devon ; and (for Colonial and Foreign subscribers) by Wheldon & Wesley, Ltd., 2, 3 & 4, Arthur Street, New Oxford Street, London, W.C.2. Price 10s. per part.

Researches on Fungi.—By A. H. REGINALD BULLER. Vol. V. 1933. xiii + 416 pp., 174 text-figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C.4. Price 25s. net.

Practical Microscopical Metallography.—By RICHARD HENRY GREAVES, D.Sc., and HAROLD WRIGHTON, B.Met. 2nd edition, Revised and Enlarged. 1933. xi + 256 pp., 311 figs., including 54 plates. Published by Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 18s. net.

This edition of the above work has a special interest for the microscopist since it describes the latest methods of the use of vertical illumination for the examination of polished metallurgical specimens.

In this Journal Mr. Wrighton has published photomicrographs showing resolution of the order of 140,000 lines to the inch in metal specimens taken with a 1·30 N.A. apochromatic object-glass. The method of illumination used appears to give the maximum resolution of which the objective is capable and reduces to a minimum the glare cast by reflections at lens surfaces ; the method is described in detail in this edition. Methods of testing the optical and mechanical parts of photomicrographic apparatus are outlined and the question of selection of equipment is considered.

There is a new chapter on low power photomicrography and macrophotography. It is shown that the production at these low powers of images in which the elements of structure are accurately portrayed is dependent upon the selection of objectives suitably corrected for the work, and on the use of properly adjusted illuminating systems. The technique is clearly described and illustrated by diagrams and photographs.

The portion of the work which deals with the microstructure of metals is greatly enlarged with numerous excellent illustrations.

The book is well printed and contains a comprehensive index.

Textbook of General Zoology.—By WINTERTON C. CURTIS, MARY J. GUTHRIE, and KATHARINE R. JEFFERS. 2nd edition, 1933. 588 pp., 438 figs. Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 23s. net.

Laboratory Directions in General Zoology.—By WINTERTON C. CURTIS. MARY J. GUTHRIE, FARRIS H. WOODS. 2nd edition, Revised. 1933, xxxii + 164 pp., 60 figs. Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 9s. 6d.

(1) This textbook is adapted to the course of General Zoology as taught by the authors in the University of Missouri to students in Arts, Science, Medicine, and Agriculture. Its peculiar feature is that greater stress is laid on general biological principles than on the description of the representatives of the various phyla. The first half of the book is intended to acquaint the student with the principles of animal anatomy, embryology, and physiology, as illustrated by vertebrates, using the frog as a type. One chapter is devoted to metabolism, circulation, respiration, and excretion. In others an account is given of cytology, histology, and genetics. In the second half of the book the various phyla of the animal kingdom are briefly reviewed in the systematic order, the final chapter being devoted to a consideration of evolution. The illustrations are numerous and well-chosen. There is a useful glossary and a detailed alphabetical index.

(2) The second book is a companion volume to the textbook. It contains laboratory instructions for the dissection and study of selected types from the various animal groups which are amply illustrated.

The two books cover a very wide field of animal biology, too wide—one might say—considering that the course in General Zoology at Missouri " consists of three one-hour lecture periods and two two-hour laboratory periods for *one semester* [reviewer's italics], during which time the student is supposed to assimilate all the essentials of zoology, histology, physiology and genetics.   C. A. H.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIA-
TION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY,
OCTOBER 18TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, *C.B.E.*, PRESIDENT
IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by
the President.

New Fellows.—The following candidates were balloted for and duly elected
Ordinary Fellows of the Society :—

Rev. Wallace H. Cauldwell.	Halifax.
Mr. Arthur S. Newman.	London.

Nomination Certificates in favour of the following candidates were read for
the first time, and directed to be suspended in the Rooms of the Society in the
usual manner :—

James Brailsford.	Derby.
Alan Evans.	Derby.
Sydney Victor Fryer.	Nigeria.
Frank Graham Whitfield.	Khartoum.
M. K. Subramaniam.	Madras.
Albert George Baxter.	S. Hackney.
Anthony Stuart Fountain.	Rotherham.
Edwin Burgess.	Welwyn.

The Deaths were reported of :—

A. D. Bell.	Elected	1908.
Prof. J. E. Talmage.	,,	1891.
J. D. Roberts.	,,	1932.
Prof. R. Ramsay Wright.	,,	1882.

Votes of condolence with the relatives were passed.

The following **Donations** were reported, and hearty votes of thanks accorded
to the donors :—

C. D. Soar, F.R.M.S., F.L.S.—

" British Hydracarina." 3 volumes. Original Drawings.

Mr. F. W. Mills, F.L.S., F.R.M.S.—

"An Index to the Genera and Species of the Diatomaceæ and their Synonyms. 1816–1932." Parts I—V. By F. W. Mills.

Casa Editrice L. Cappelli.

"Le Teorie sull' Origine e l'Evoluzione della Vita (da Darwin ai Nostri Giorni)." By Gustavo Brunelli.

M. Paul Lechevalier.—

"Faune de France." Vol. 26. "Copepodes pelagiques." By M. Rose. Vol. 27. "Tuniciers." By H. Harant and P. Vernieres.

A. Earland—

"Foraminifera." Part 2. South Georgia (*Discovery* Reports. 1933). By A. Earland.

Messrs. McGraw-Hill, Publishing Co.—

"The Fresh Water Algæ of the United States." By Gilbert M. Smith.

Messrs. Bausch & Lomb, Optical Co., Ltd.—

Replica of Leeuwenhoek's Microscope. *c.* 1665.

The late Mr. Abram Flatters, per the Misses Horrocks.—

"Methods in Microscopical Research." By A. Flatters. 1905.
"Cotton." By C. P. Brooks. 1898.
"Structural Botany." By Asa Gray. 1880.
"The Cotton Plant." By A. Flatters. 1906.
Manuscript Copy of "Structural Botany." By A. Gray, copied by A. Flatters.
2 Boxes of Micro-slides.

The Misses Harman—

3 volumes. Original drawings of Infusoria. By the late J. E. Tatem.

Mr. John A. Long—

152 Species Slides of Diatoms.

Messrs. Chapman & Hall—

"Elements of Optical Mineralogy." By A. N. Winchell. 3rd edition, Part 2.
"Text Book of General Zoology." By W. C. Curtis and M. J. Guthrie.
"Elements of Botany." By R. M. Holman and W. W. Robbins. 2nd edition.
"Laboratory Directions in General Zoology." 2nd edition, revised. By W. C. Curtis, M. J. Guthrie, and F. H. Woods.
"Phytopathological and Botanical Research Methods." By T. E. Rawlins.

Miss Lucy Boyd—

"Monocotylous Seedlings." By Lucy Boyd, D.Sc.

The Royal Society—
> One Hundred Pounds. (£100.)

Purchased by Members of Council and presented to the Society—
> An Early Binocular Microscope by Nachet.

Trustees of the British Museum.
> " Index Animalium." Parts XXXII and XXXIII. By C. D. Sherborn.

Signing the Roll.—The following gentleman being present, and having subscribed his signature to the Roll of Fellowship, was received by the President and admitted a Fellow of the Society :—

> Mr. Arthur S. Newman.

Papers.—The following communications were read and discussed :—
Mr. Harold Wrighton, B.Met., F.R.M.S.—
> " A New 1·6 N.A. Monochromatic Objective."

Prof. T. K. Koshy, M.A., F.R.M.S.—
> " Chromosome Studies in Allium."

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room on Wednesday, November 1st, 1933.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY NOVEMBER 15TH, 1933, AT 5.30 P.M., MR. CONRAD BECK, C.B.E., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Mr. Albert G. Baxter.	S. Hackney.
Mr. James Brailsford.	Derby.
Mr. Edwin Burgess.	Herts.
Mr. Alan Evans.	Derby.
Mr. Anthony S. Fountain.	Rotherham.
Mr. Sydney V. Fryer.	Nigeria.
Mr. M. K. Subramaniam, B.A.	Madras.
Mr. Frank G. S. Whitfield.	Khartoum.

Nomination Certificate in favour of the following candidate was read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

<div style="text-align:center">Robert Angus Hunter.   Bridge of Weir.</div>

The Death was reported of :—

<div style="text-align:center">James Williamson.   Elected 1930.</div>

A vote of condolence with the relatives was passed.

The following **Donations** were reported, and hearty votes of thanks accorded to the donors :—

The Biological Stain Commission, Geneva, N.Y.

" The History of Staining." By H. J. Conn.

Messrs. Chapman and Hall, Ltd.—

" Fluorescence Analysis in Ultra-Violet Light." By J. A. Radley, B.Sc., A.I.C., and Julius Grant, Ph.D., M.Sc., F.I.C.

F. W. Mills, Esq., F.L.S., F.R.M.S.—

" An Index to the Diatomaceæ." Part VI. Ch–Co, 1816–1932. Compiled by F. W. Mills.

Sydney H. Robinson, Esq., F.R.M.S.—

12 Micro-slides.

Papers.—The following communications were read and discussed :—

Prof. D. M. Blair, Dr. F. Davies, and Mr. W. E. Williams—

" Microphotography with Infra-red Plates."

Mr. J. E. Barnard, F.R.S.—

" A New Microscope."

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room on Wednesday, December 6th, 1933.

The Proceedings then terminated.

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